APPENDIX 1

Summary of Angler Survey
Saltwater Sport Fishing off the Kenai Peninsula, Alaska.*

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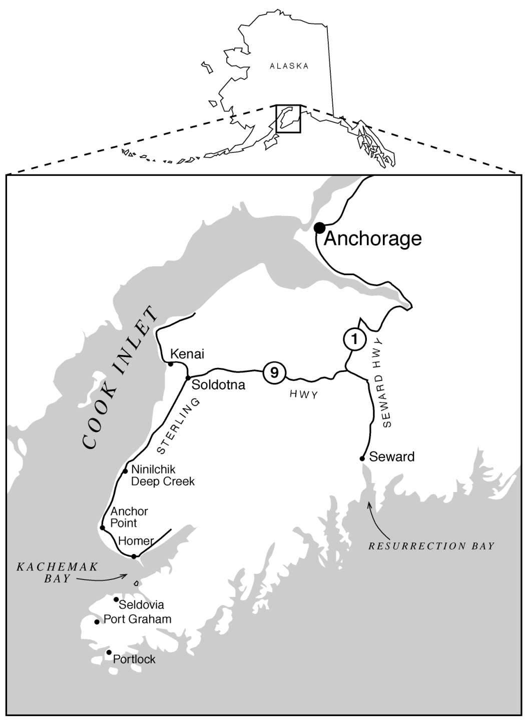

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APPENDIX 2

Total Expenditures Assuming That Less Than 100% of Each Trip Was Attributable to Fishing— Because there are many reasons that a visitor may visit Alaska, not all of the visitation days will be cancelled when a fishing trip to the Kenai Peninsula is cancelled. In this appendix we will present the calculations for the estimation of the amount of days that would be reduced on the Kenai when fishing days are reduced. This is a work in progress and the actual numbers are likely to change slightly as we fine-tune these estimations. (Estimations for the Kenai reduction are likely to change very little in the final analysis however estimations of the Alaska portion may change more.) Again, in the UAF survey nine primary trip purposes were identified originally in Table 3.20. The primary reasons that a Kenai saltwater fishing trip was taken are reproduced in Table 2A.1.

Table 2A.1—Primary purpose of visit to Alaska for Kenai Peninsula saltwater halibut and salmon anglers from the Lee et al. (1999) *by trip*.

	Alaskans	Non-Residents
Fishing on Kenai main reason	87.7%	43.0%
Visit/Vacation Alaska	2.5%	24.4%
Kenai Freshwater fish	4.9%	12.0%
Relatives	2.0%	11.2%
Business	1.0%	3.7%
Saltwater/freshwater fishing	0.5%	2.5%
Visit Friends	1.5%	0.4%
Cruise Ship	0%	1.2%
Hunting	0%	1.7%

However, as it was noted, there is a difference between the total amount of *trips* identified by trip purpose and the total amount of trip fishing *days* identified by trip purpose. Table 2A.2 summarizes the percent of total trip *fishing days* attributable to the primary purpose of the trip.

Table 2A.2—Primary purpose of visit to Alaska for Kenai Peninsula saltwater halibut and salmon anglers from the Lee et al. (1999) by *fishing days*.

	Alaskans (less locals)	Non-Residents
Fishing on Kenai main reason	88.1%	51.0%
Visit/Vacation Alaska	2.2%	23.2%
Kenai Freshwater fish	1.4%	8.8%
Relatives	5.2%	10.1%
Business	1.2%	2.9%
Saltwater/freshwater fishing	0.2%	2.2%
Visit Friends	1.6%	0.5%
Cruise Ship	0.0%	0.7%
Hunting	0.0%	0.7%

Of course, it is assumed that if the fishing trip is cancelled that all of the days fishing would be cancelled. More pertinent to the calculations of effected total trip days spent on the *Kenai* are the days spent on the Kenai by trip purpose. These figures are reported in Table 2A.3.

APPENDIX 3

The Relationship Between Exvessel Revenue and Halibut Quota: Some Observations

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Introduction

The relationship between quantities of raw goods produced and revenues generated to the primary producer is a much discussed economic relationship. In the case of Pacific halibut this fishery-wide relationship is between policy-regulated total allowable catch (TAC) and resulting exvessel revenues generated to the halibut fleet. The revenues that fishermen will eventually receive depend on many factors such as their relative bargaining strength with their buyers (normally the processors), the cost of processing and getting the fish to the end-markets, and the strength of the market for the final product. This paper will briefly examine these relationships, especially the relationship between the TACs and the derived exvessel demand for the final product. In particular, previous works will be examined where this relationship has been quantified and an extension of one of these studies will be reported.

Recent complications to the market structure between halibut landings and exvessel prices make quantifying the relationship difficult at best. In particular, three events make the estimation of demand curves difficult. The first was the move of the British Columbia Pacific halibut fishery to individual vessel quotas (IVQs) in 1991. To the extent that BC Pacific halibut and Alaska Pacific halibut are substitutes this will have an effect on the exvessel revenue for Alaska Pacific halibut (evidence for a significant substitution effect is found in Herrmann 1996[1]). More importantly, a second structural change to the harvest-price relationship took place in 1995 when the Alaska Pacific halibut fishery was prosecuted under the individual fishery quota system (IFQs). Finally, the rapid increase in the TAC starting in 1997, after two years of relatively low harvests, further complicates estimation of a exvessel demand curve using historical data.

In fishing industries, such as halibut, in which the fishing season under a regulated open-access management had been reduced to just a few days, IFQs have had the great advantage of being able to extend the fishing and marketing season. This allows for increases in fresh fish sales, better product quality, and a wider choice of processing options for the fishers, including direct

[1] In a study for the Saltonstall-Kennedy program, Knapp (1997) finds that for the post-Alaska halibut IFQs fishery "Except for possible quality advantages resulting from shorter transportation distances and time to market there is no longer any reason for market conditions to differ substantially for Canadian and Alaska fresh halibut".

marketing. Wilen and Homans (1994) provide a theoretical discussion of the marketing losses that occur in absence of an individual quota system (open access fisheries):

> Marketing losses occur in open access or regulated open access fisheries for several reasons. Foremost among these is poor quality raw product associated with the race to catch fish (gear damaged fish, undersized fish, lack of on board handling). Additional factors include reduced quality wholesale product associated with capacity bottlenecks, freezing deterioration, and inability to market when fewer substitutes are available. All of these translate into lower ex-vessel prices, which in turn affect the process of rent dissipation.

A distinct advantage in the halibut fishery was changing the end-product form from predominately frozen to predominantly fresh (Herrmann 1996). This is especially true in British Columbia whereas approximately 40% of British Columbia halibut was marketed fresh in the pre-IVQ period, approximately 94% has been marketed fresh in the post-IVQ period (Casey et al. 1995). The share of fresh production has also increased in Alaska although it is not theorized to approach B.C.s fresh production. Knapp (1997) theorizes that the reason the Alaska fresh halibut share remains below the BC share may include the higher cost of transportation of fresh halibut from Alaska than B.C., the limited capacity to handle fresh halibut in Alaska, and the effect of the bigger Alaska harvest on the fresh market prices.

Basic economic theory explains that when quantities increase (decrease), all other factors unchanging, price will fall (rise). The effect on total revenue will depend on how sensitive prices are to quantities. If, for example, quantities rise and the resulting percentage price decrease is less than the quantity percent increase then exvessel revenues will rise (this may or not lead to an increase in profits depending on the rise in costs associated with the increased harvests). However, if the percentage decrease in price is more than the percentage increase in quantity then revenues will fall[2]. One way to examine this relationship is by a cursory, or graphical, examination of the data. The problem with relying exclusively on graphical analysis is that there are many factors that affect the price of halibut and decoupling these (including the quantity effect) by visual examination is not possible. However, examination of the data can lead to many interesting initial observations.

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[2] Economists often report the first-round price-quantity interactions using own-price elasticities (or flexibilities). This will be discussed later.

Pacific halibut exvessel price data is shown in figure 1 for Alaska and British Columbia.

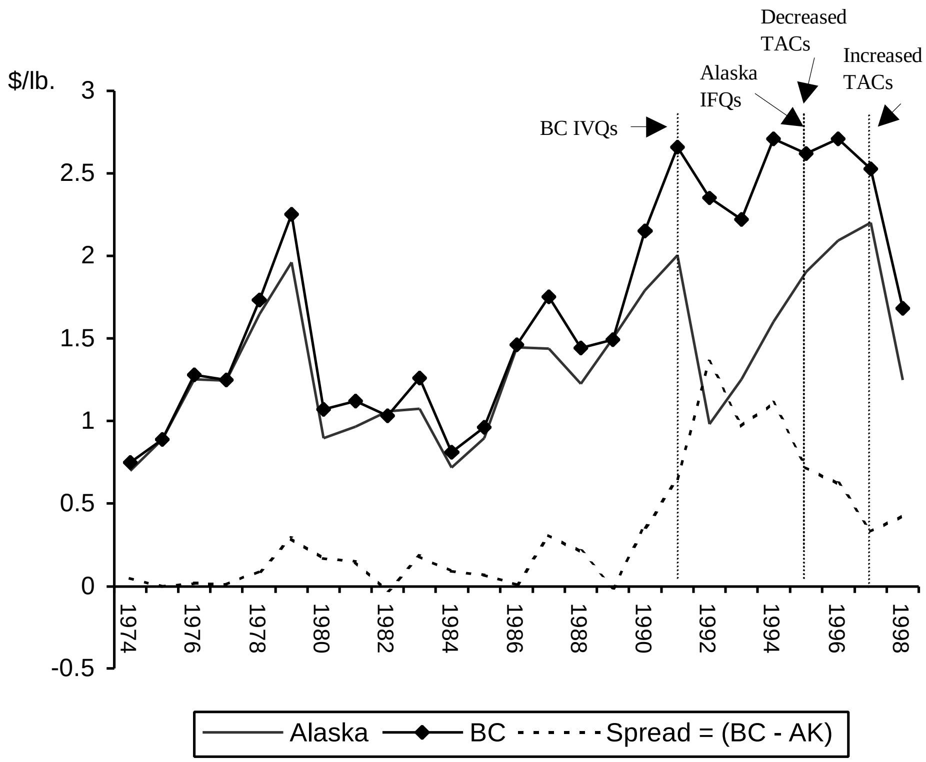

Figure 1. Nominal Exvessel prices received for Pacific halibut in British Columbia (BC) and Alaska, 1974-98 ($/lb.).

It is evident from this data that the spread between BC and Alaska exvessel prices increased between the years 1991-1994 when the BC fishery was prosecuted under the IVQ system and the Alaska fishery was still regulated open-access. In 1990, B.C. halibut prices were $0.36/lb. higher than Alaska prices. From 1991-1994, the period of B.C. IVQs and before Alaska IFQs, B.C. exvessel prices averaged $1.02/lb. higher. After 1995, when the Alaska fishery went to IFQs, the spread decreased to an average of $0.53. The fact that the spread is still higher than pre-B.C. IFQs is most likely due to the fact that B.C. has been able to maintain a higher fresh share than has Alaska (Knapp 1997).

Alaska prices rose in 1995 when the IFQs went into effect and TACs were reduced. Prices continue to rise into 1997 even as the TAC was increased by 40%. The 1998 prices then took a rapid decline. The high prices in 1997 and the low prices in 1998 are probably both a bit misleading if one only studies them in isolation to harvest levels. A large portion of the 1997 harvest was held back into inventories, thus keeping prices stronger than they would have been if the total increase in the TAC had been sold. Then, in 1998, these inventories were released into the market decreasing the price further than the strong harvest alone would have done. (These complicating factors are one reason that economists do not rely solely on visual examination of data for analysis but use statistical analysis (such as econometrics) to attempt to sort out the harvest-price relationships in isolation).

Figure 1 is redrawn for the Alaska exvessel price by using the "real" prices instead of nominal prices. This was done by deflating the Alaska price by the U.S. producer index for foods and feeds (base period 1974).

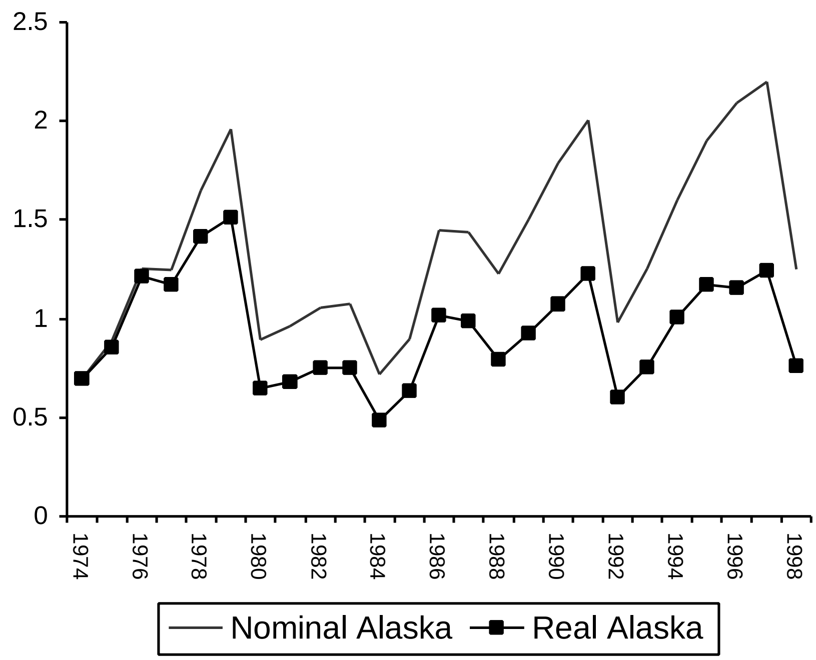

Figure 2. Nominal and Real exvessel prices and received for Pacific halibut in Alaska, 1974-98 ($/lb.).

“Real” prices will change depending on the deflator, but in any case, it is important to note that examining just the nominal exvessel prices may give the false impression that halibut prices have increased over this time period. Examining the real prices over this time period gives a different picture of peaks and valleys but no overall sustained trend either up or down.

Figure 3 shows the combined harvest of Pacific halibut in British Columbia and Alaska and the combined nominal exvessel revenue.

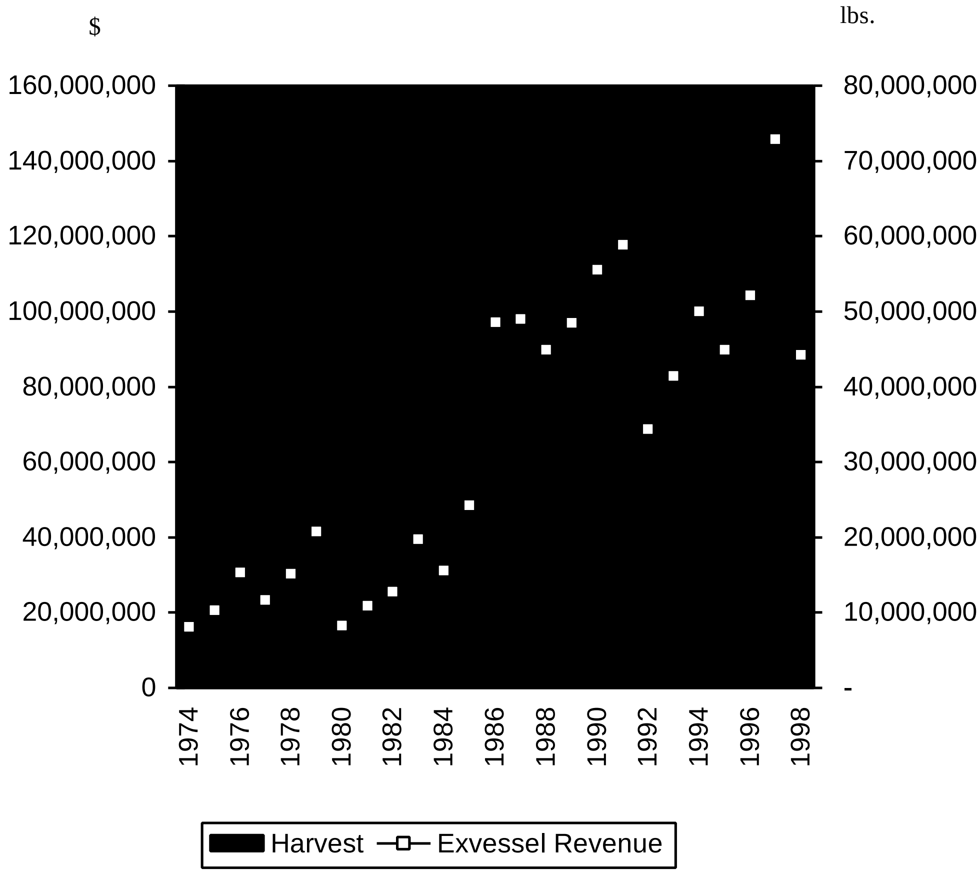

Figure 3. North American Pacific halibut harvests and nominal exvessel revenue (U.S. dollars) from 1987-1998.

In nominal terms a clear trend exists, over the 1974-1998 time period, of increasing harvests and increasing revenues. Revenues dip slightly during the BC period of IVQs before the Alaska IFQs, but rebound during the post Alaska ITQ period until 1998 when they decline precipitously. Redoing the nominal exvessel revenue in figure 3 to real exvessel revenue gives us figure 4 (again based on 1997 and deflated by the PPI for foods and feeds).

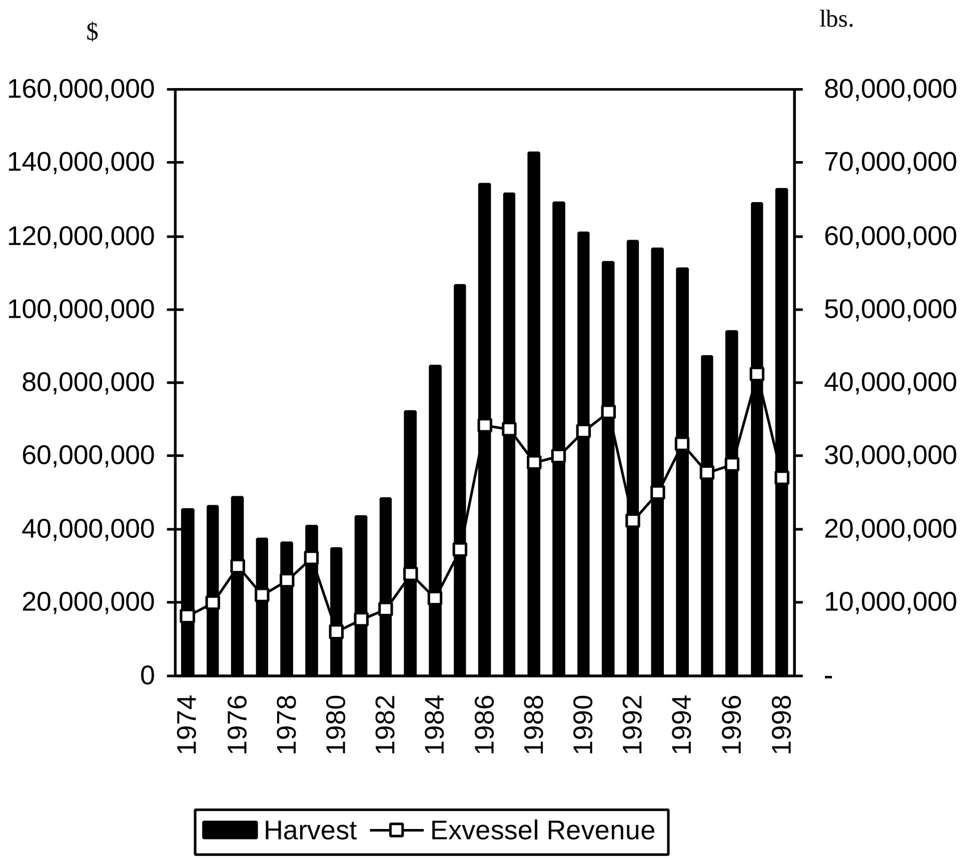

Figure 4. North American Pacific halibut harvests and real exvessel revenue (U.S. dollars) from 1987-1998 (base 1974 deflator U.S. producer price index for foods and feeds).

Examining the real halibut exvessel revenue shows less of a clear increase. Initially, with increases in harvest, exvessel revenue increases (1980-1986). Starting in 1986 North American real exvessel revenues remain relatively flat with annual peaks and valleys. In 1997 exvessel revenues rise with the increase in TACs but then decrease in 1998. Again, part of this is due to inventory level changes. Figure 5 shows the inventories of dressed frozen halibut.

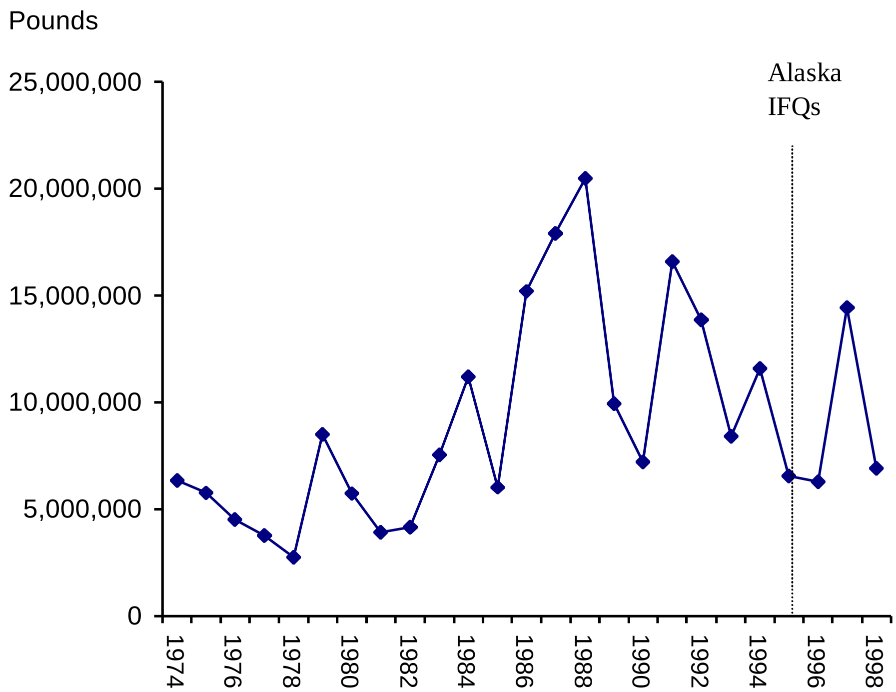

Figure 5. U.S. Inventories of round and dressed Pacific Halibut 1974-1998.

In 1996 the ending U.S. inventory of dressed Pacific halibut was 6.3 million pounds, in 1997 it was 14.4 million, and in 1998 it was 6.9 million[3]. That means that there was a net decrease of 8.1 million pounds of frozen dressed halibut sold in 1997 from the catch and an increase of 7.5 million pounds of frozen halibut added to the 1998 harvest[4]. Clearly, without looking at the yearly fluctuations in inventory holdings it is difficult to isolate the effects of harvest.

[3] Before halibut IFQs were introduced in the Alaska fishery cold storage holdings were held to meet the demands of the entire year. Toward the end of the open-access fishery the reported December ending inventories needed to meet the frozen demand until the June openers. The amount of cold storage holdings increased over the years as the seasons became shorter and the new year's opener further away from the end of the previous year. With the IFQ fishery beginning in March there is less demand for ending December inventories and therefore inventory holdings have generally declined starting in 1995.

[4] There also some relatively minor holdings of halibut steaks and fillets.

With the introduction of BC IVQs and Alaska IFQs there has been an increase from frozen to fresh production as season length has increased. Before the introduction of individual quotas, increased fleet size and harvest power had dramatically decreased season lengths (see Figure 6).

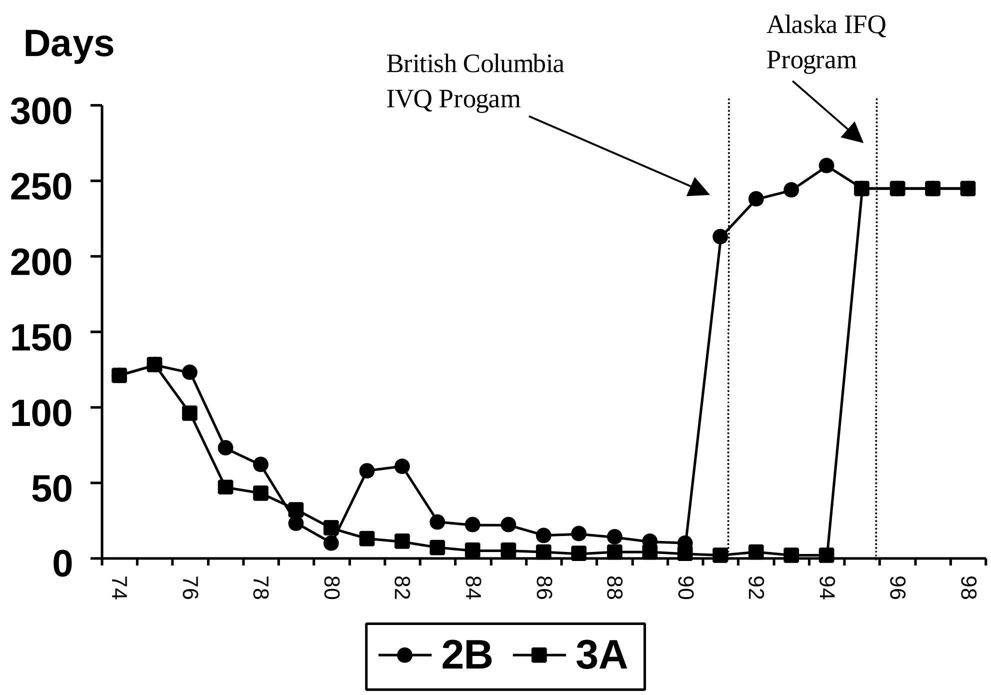

Figure 6. Length of fishing season for Pacific halibut from 1974 to 1998 for IPHC-managed areas in British Columbia (2B) and Alaska (3A)

From 1974 (the beginning of the modeling period) to 1990 (the last year before IVQs were imposed), the season length in British Columbia declined from 121 to 10 days and to just 2 days for Alaska (Area 3A) by 1994. Following the implementation of IVQs, the season length increased to 260 days and now is regulated at 245 days for both British Columbia and Alaska.

A Closer Examination of Some Recent Data

Although there have been several economic studies analyzing different aspects of the North American Pacific halibut fleet, there have been few that analyzed halibut markets and even fewer that have attempted to statistically estimate the relationship between harvest levels and exvessel price and revenue. The lack of a time series of consistent market data has limited the sophistication of the models.

The simplest model directly estimates the relationship between harvest and exvessel price by regressing quantity on price. The theory behind this is that if the demand relationship is stable (i.e. the demand for halibut, at any given price, does not change over time) then by observing the changing total allowable catches (policy driven) a demand curve can be traced out. Figure 7 illustrates this.

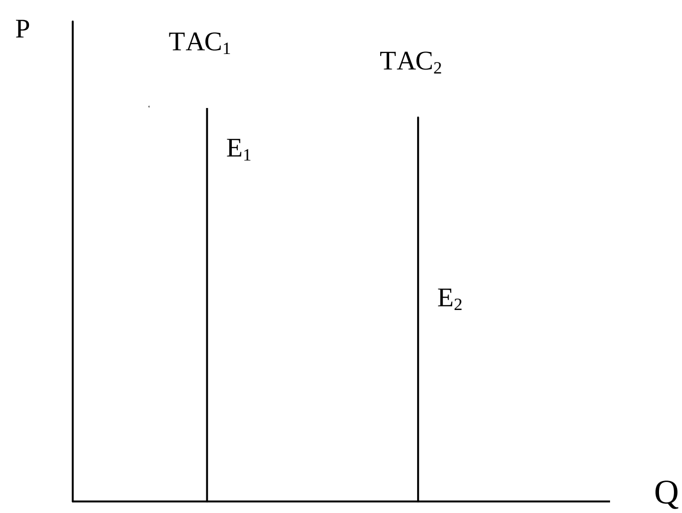

Figure 7. Illustration of tracing out a demand curve for a constant demand over time and changing total allowable catch.

When the total allowable catch decreases from period 1 to period 2, if demand is stable, a demand curve can be traced out by connecting these two equilibrium points (E_1 and E_2). This is basically the same approach taken by Criddle (1993) as part of a bioeconomic analysis of the Pacific halibut fishery. Criddle used an IPHC price series that combined Canada and United States exvessel prices and regressed North American halibut harvest from 1935 to 1992. He states that he is not formally trying to estimate a demand curve and is only using the simplified equation for “expository purposes” to use in his bioeconomic analysis. We will use his model for the same purpose here as a starting point. Criddle estimates that

(1) $P_t = \$1.915 - 0.018h_t$

where P_t is the real exvessel price of North American Pacific halibut ($/lb.) and h_t is the North American landings (million of pounds). His equation would indicate that a one million pound increase in landings would lower the real exvessel price by 1.8 cents. This model was estimated with data through 1992 just one-year into the B.C. IVQ program.

To examine how this simple demand model might predict the most recent changes to halibut price we examine the last four years of halibut harvest and prices under the Alaska IFQs. Table 1 shows that 1995 and 1996 have similar harvest levels as do 1997 and 1998.

Table 1. North American Pacific Halibut landings in pounds and nominal exvessel price in U.S.$/lbs. (1995-1998).

Year	AK Landings	Ak exvessel price	BC Landings	BC exvessel price	Combined Landings	Combined exvessel price
1995	33,960,000	1.900	9,620,000	2.62	43,580,000	2.06
1996	37,490,000	2.090	9,530,000	2.71	47,020,000	2.22
1997	52,365,000	2.200	12,100,000	2.53	64,465,000	2.26
1998	53,448,000	1.250	12,876,668	1.68	66,324,668	1.33

As was mentioned previously, the inventory holdings for 1997 were very high. This kept prices higher in 1997 than if all the halibut had been put on market and lowered prices in 1998 as the leftover inventory was sold. As 1995, 96, and 98 ending inventory levels were all similar, to smooth out this effect, it is useful to view the average changes from the 1995-1996 harvest and price levels to 1997-1998 levels. This is also a meaningful aggregation in that 1995 and 1996 were two years of very low TACs with and 1997 and 1998 were two years with very high TACs. Table 2 show the average 1995-96 and 1997-98 landings and prices.

Table 2. North American Pacific halibut landings in pounds and nominal exvessel price in U.S.$/lbs. (average of 1995-96 and 1997-98)

Year	AK Landings	Ak exvessel price	BC Landings	BC exvessel price	Combined Landings	Combined exvessel price
1995-96	35,725,000	2.00	9,575,000	2.67	45,300,000	2.14
1997-98	53,448,000	1.72	12,488,334	2.08	66,324,668	1.79

From 1995-96 the combined North American landings of Pacific halibut (ignoring the small amount landed in Washington) increased by 21 million pounds and exvessel price decreased by 35 cents. If the Criddle model were applied it would have predicted a price decrease that was remarkably similar of approximately 38 cents (-1.8 x 21 million pounds)[5]. Although Criddle's specification, P=f(Q), does not properly identify a demand curve over this range, the equation predicted the price changes using average years fairly well (see Table 3)

Table 3. Halibut landings in pounds and nominal exvessel price in U.S.$/lbs. (1995-1998).

Year	Combined Landings	Combined exvessel price	Change in Price (cents per pound)	Predictions from Criddle Model
1994	55,590,000	1.80		
1995-95	45,300,000	2.14	+34	+18
1997-986	66,324,668	1.79	-35	-38

However, if one looks at the four years in isolation, Criddle's expository exvessel demand equation does not come close to predicting the price changes (see Table 4).

Table 4. North American Pacific halibut landings in pounds and nominal exvessel price in U.S.$/lbs. (1995-1998).

Year	Combined Landings	Combined exvessel price	Change in Price (cents per pound)	Predictions from Criddle Model
1994	55,590,000	1.80		
1995	43,580,000	2.06	+26	+14
1996	47,020,000	2.22	+16	-6
1997	64,465,000	2.26	+ 4	-32
1998	66,324,668	1.33	-93	-4

5 Since Criddle's model is using real prices these predictions are not directly comparable, however, over this 4 year period general prices moved very little

If instead of viewing landings in isolation, examining changes in total available supply (landings less change in year-end inventory) the Criddle model comes closer in predicting the decline between 1997 and 1998 (see Table 5).

Table 5. North American Pacific halibut landings in pounds and nominal exvessel price in U.S.$/lbs. (1995-1998).

Year	Combined Landings (less U.S. frozen inventory[6] changes)	Combined exvessel price	Change in Price (cents per pound)	Predictions from Criddle Model
1997	56,961,000	2.26		
1998	73,828,668	1.33	-93	-31

The problem with assuming that a demand curve can be traced out by examination of the price–quantity relationship in isolation, even in a fishery where supply is invariant to price, is that demand does change over time. By contributing all effects of price (even real prices) movements to quantity is assigning too much importance to the quantity effect. To illustrate this we can think of any generic product whose per-capita demand is static over-time (a very unrealistic assumption) to all factors except population. As population increases over time the total demand increases although per-capita demand does not. Let's take two time period where both population and TAC has increased significantly.

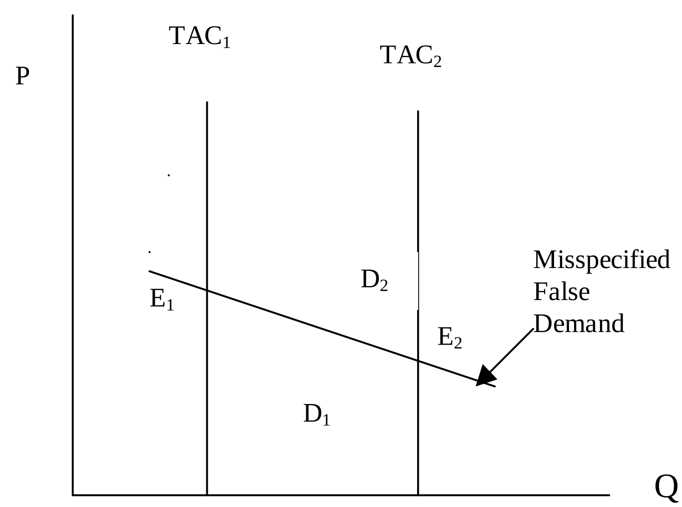

Figure 7. Illustration of tracing out a demand curve for a constant demand over time and changing total allowable catch.

6 This is not quite an accurate representation since the frozen dressed halibut yield may be slightly lower than the dressed landings.

E_1 and E_2 represent two equilibrium points. Demand has shifted from D_1 to D_2 because increases in population means that for every given price more of the total good is demanded. If a demand curve is traced out through the two equilibrium points, as is the case in a P=f(Q) specification, a misspecified demand curve is estimated. This misspecified demand relationship would lead one to believe that price is not very sensitive to quantity. But it may be that price is fairly sensitive to quantity (the true demand curves are shown as D_1 and D_2) but the reason that price has not fallen more, with an increase in quantity, is that there are more consumers to consume the product. If the false demand curve is used to estimate the price decrease over a given year (when population is fairly steady) it will underestimate a price decrease for an increase in quantity because the slope of the misspecified demand curve is flatter than the true demand curves. There may be many reasons that a derived demand curve will shift over time (either outward or inward) including changes in population, prices of other goods, tastes and preferences, product quality, seasonal variation, cost factors etc.

Price Elasticity and Flexibility

Elasticity measures a percentage change in one variable given a percentage change in another. It is a common means of measurement in economics and, though often misused, it can be useful if the limitations are understood. It is also a first-round effect in that it does not measure the total effect that can be measured in dynamic simulations of systems of equations (which models market interactions). For instance, a change in a market factor that directly affects the price for U.S. halibut (first-round effect) may also affect the price of imported Canadian halibut which in turn affects the price of U.S. halibut (second round effect) and so on. We can also view the first round effects in light of the halibut inventory problem of 1997 and 1998 as mentioned previously. Whereas an elasticity (in this case a price flexibility[7]) might indicate a certain direct relationship between landings and exvessel price ignoring inventory level fluctuations (second round effects) will mitigate some of the predictive power of the elasticity. For example if TACs rise, from a price-flexibility, we might predict a sizeable decrease in price. However, some harvest may be stored in inventory negating the some of the price decrease. Of course, this inventory may be

[7] Whereas a own-price elasticity of demand measures the percentage change in quantity to a one-percent change in price a price flexibility measures the percentage change in price to a one-percent change in quantity. It sets the lower limit on a price elasticity.

dumped the following year. The best way to model this type of behavior is to build a system of equations including, inventory equations, and to perform dynamic simulations.

Ignoring these limitations of elasticities (and price flexibilities) they can still can be useful for quick analyses. The equation for a price flexibility (derived from an estimated inverse demand equation) is $\partial P/_{\partial Q} * Q/_{P}$. A price flexibility measures how sensitive prices are to quantities. If a one-percent increase in quantity, all other factors held constant, decreases (increases) price by less than one-percent total revenues will increase (decrease) and vice versa. So, for example, if one finds a price flexibility of –0.5 this would indicate that if quantity increased by one-percent price would decrease by 0.5 percent leading to an increase in revenues (see Table 6 for an example).

Table 6. Matrix **e**xample of revenue effects for changing quantities for sample price-flexibilities.

	Price Flexibility = -0.5	**Price Flexibility = -1.0**	**Price Flexibility = -1.5**
	Low Price Sensitivity to Landings	***Medium Price Sensitivity to Landings***	***High Price Sensitivity to Landings***
Quantity Increases	Revenue Increases	Revenue is unchanged	Revenue Decreases
Quantity Decreases	Revenue Decreases	Revenue is unchanged	Revenue Increases

To add more confusion, the inverse of a price flexibility is a price elasticity and has the opposite effect on revenue whether the amount is above or below –1.

An advantage of the linear demand specification is that the price flexibility changes over the demand curve. This adds realism into the measurement. At times of low harvests, prices are usually less sensitive to changes in harvests and total revenues may increase (decrease) if harvests increase (decrease) and vice versa. At relatively high harvest levels prices are more sensitive to changes in quantities and total revenues may decrease (increase) if harvests increase (decrease). Again, examining data from the last four years we can see the most recent relationship between exvessel revenue and landings (Table 7).

Table 7. North American Pacific Halibut landing, nominal exvessel prices and revenues in U.S.$/lbs. (1995-1998).

Year	Combined Landings	Combined exvessel price	Combined exvessel revenue
1995	43,580,000	2.06	55,366,010
1996	47,020,000	2.22	57,616,777
1997	64,465,000	2.26	82,331,444
1998	66,324,668	1.33	53,985,002
	Averages		
1995-96	45,300,000	2.14	96,986,689
1997-98	65,394,834	1.79	117,119,727

Again, one can view this data in isolation and calculate arc-price flexibilities[8] where the price changes are attributed entirely to the changes in landings. If one measures the arc flexibility from the data alone for the period of 1995-96 to 1997-98 it is –0.47 which would indicate that a one-percent increase in landings will decrease price by only 0.47 percent raising total revenues (which is driven by the rising total revenues in these two time periods). However, if one calculates the price flexibilities between 1997 and 1998 it is –18.21 which indicates that any increased in landings will be devastating to total revenues.

If one replaces landings, with changes in total supply released onto the market (landing less change in ending inventories -- Table 5) one finds a arc price-flexibility from 1997 to 1998 of –2.0 which still indicates that the market has been saturated[9].

Again, using the Criddle expository exvessel demand equation is $P_t = \$1.915 - 0.018h_t$ his point price flexibilities[10] calculated and shown in Table 8[11].

[8] An arc price flexibility estimates the changes over a range instead of a point.

[9] "Saturated" here means that the market is at a point where additional harvests will mean lower exvessel revenues.

[10] Actually, to be on Criddle's demand curve a flexibility would need to be estimated from the estimated flexibility = $\partial\hat{P}/\partial Q * Q/\hat{P}$ where $\hat{P} = 1.96 - 0.18\ h_t$ since not all actual points lie on the demand curve. Using actual point data would misrepresent his estimated demand curve by shifting it to fit through one observation. However, I did not have his actual data so I used the actual prices

Table 8 Point Price Flexibilites from the Criddle Model (1995 – 1998)

1995 landings	-0.380
1996 landings	-0.381
1997 landings	-0.513
1998 landings	-0.897

So, if Criddle's equation were a demand curve, and again, we are only using it for exposition, we could say the following. As the landings increased from 1995 – 1998 prices become more sensitive to changes in landings but never reached a point where increases in landings would decrease first-round exvessel revenues to the fishery, all other factors constant.

Estimation with Structural Changes from 1991 to 1998.

In the introduction we examined possible structural changes to the halibut markets because of changes in the fishery prosecution with the introduction of BC IVQs in 1991 and the Alaska IFQs in 1995. Theory indicates that the total demand for North Pacific Halibut is likely to shift out during both of these time periods as more fresh halibut enters the market and replaces frozen halibut throughout much of the year. In addition, demand should strengthen because of higher harvest quality and the increased ability of fishermen to fish within the year at times when demand is strongest.

Because of these structural changes using a static price-quantity relationship, for a given time period, will lead to model misspecification. Ignoring the demand shift, resulting from the quotas will bias the estimated quantity coefficient downward (in absolute value). The following simple example will illustrate this point. Re-estimating the Criddle model with the same data (except deflating price with the U.S. producer price index instead of the GNP implicit price deflator) from 1960 to 1998 yielded the following equation.

$P = 0.016554 – 0.00009639H_t$

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instead of the predicted ones that would come off his demand curve. Since these calculations are only for illustration these can surfice for now.

(Since price is in real terms it is not possible to examine the equation and read the direct price effect of quantity on price. However, transforming the slope coefficient to correspond to nominal price this equation indicates that a million pound increase in landings decreases price by 1.1 cents. The price flexibility is –0.54 indicating that prices are not overly sensitive to changes in quantities. Further examination of the estimation reveals an R^2 of 0.13 that indicates that the variation in quantity explaines 13% of the variation in price. Also, the estimation has significant first-order serial correlation probably indicating a misspecification of the demand curve.

The model is re-run using a very simple intercept shift to mark the post-quota years. This is done by creating an indicator variable that is 0 for 1964-1990 and 1 beginning in 1991. The new equation is

$$P = 0.016595 - 0.00011832\ h_t + 0.0051749\ \text{Quota}$$

Again, transforming the slope coefficient to nominal prices, this equation indicates that a 1 million pound increase in landings will lower prices by 1.4 cents per million pounds. It also suggests that the outward shift in demand, due to the quota, raised the price of halibut (at more than a 99% statistical significance level). The 1998 price flexibility is –0.66. The R^2 was 0.32 indicating a better fit. The equation still show significant serial correlation, not surprising, as the inverse exvessel demand curve is still misspecified. But for illustration purposes this shows that ignoring the outward shift in demand will lead the estimation of the demand curve to exhibit a downward bias on the absolute values of the slope coefficient (leading one to believe that price is less sensitive to quantity than it really is).

Literature on Inverse Exvessel Demand Curves and Comment.

The following is a summary of works that attempt to quantify the harvest-exvessel relationship. In some of these works the estimation of a demand curve was the central focus. In others, it was necessary component of a model dedicated to other issues in halibut management.

Schellberg (1993)

[11] Although I could not find the exact same price deflator that Criddle used I did find a similar implicit GDP deflator and have assumed a price increase of 31, 33, 35, 37 percent since his base year of 1982.

Schellberg (1993) estimated a derived exvessel demand equation for halibut landed in the Seattle port from 1946 to 1977 for use in a study dealing with the socially optimal rate of capitalization of halibut vessels. Using a logarithmic formulation, Schellberg estimated the real exvessel price as a function of the harvest and a time trend. (In his final estimation, the time trend was dropped because it was statistically insignificant). Schellberg found a constant price flexibility of –0.60 for the time period of 1946-1977. Because this is basically the same approach taken by Criddle (1993) it will not be further examined. Additionally, using a logarithmic scale imposes a constant elasticity which does not allow us to examine changes in price sensitivity to landings as landings change.

Cook and Copes 1987.

In studying the optimal levels of the Canadian Pacific halibut catch, Cook and Copes (1987) estimated Canadian exvessel price as a function of Canadian harvest, season length, and the price of salmon. Unfortunately, little detail is given about this demand equation.

Lin et. al. 1988.

Lin et al. (1988) estimated a single exvessel inverse demand equation for North American Pacific halibut using IPHC annual data from 1955 through 1984. The equation, that was determined to be their best, has the real exvessel price (combined Canadian and U.S.) to be dependent on the North American landings, the length of the halibut season (area 3A), U.S. cold storage holdings (head-off dressed halibut), and the U.S. real wholesale price of all finfish (now labeled as the producer price index). The real expenditures for food was initially included in the original derived demand equation but was not found to be significant.

Results from this model find a mean-level exvessel price flexibility of –0.18 suggesting that the halibut landings could be expanded significantly from this period mean level, all else equal, with revenues also increasing. (Examining the landings-exvessel revenue relationship after 1984 in figure 4 shows that this is indeed what happened.) Their equation also indicated that a 1% increase in the number of fishing days would increase exvessel price by 0.15%, the first study to quantify a benefit to an individual transferable quota program that would lengthen the fishing season.

The Lin et al. model also found that a 1% increase in cold storage holdings would depress price by 0.27%, and that a 1% increase in the wholesale price of finfish will induce a 1.16% increase in the price of halibut. The authors noted that a simultaneous equation model that included exvessel, cold storage, wholesale, and retail demand would be preferable in order to remove any possible simultaneous equation bias. Unfortunately, sufficient data for this type of detailed analysis were not available.

Homans 1993.

As part of a larger work on regulated open access resource exploitation, Homans (1993) was the first to separate out an exvessel price and wholesale price equation for North American Pacific halibut. The wholesale price equation was estimated with two-stage least squares, where wholesale price was modeled as dependent on harvest, marketing period length, and a lagged wholesale price. The exvessel price equation was estimated using ordinary least squares and modeled as a function of current and lagged wholesale price, current and lagged harvest, and the marketing period. The theory behind this formation is that the market adjusts at the wholesale price level, and the exvessel price is then formed, in part, as a markdown of wholesale price. The estimation period was from 1959 to 1978, using wholesale price data for frozen Pacific halibut. Among other findings, Homans estimated a long-run wholesale own-price elasticity of -1.16. Exvessel price flexibilities were found to range between –1.12 and –1.59, depending on marketing period, indicating that the market at the exvessel level was saturated.

Herrmann (1996)[12]

Herrmann expanded on the Homans model by modeling the Canadian Pacific halibut market. He built a three equation simultaneous supply and demand model to describe the process by which the British Columbia exvessel price is formed. The modeled equations include the U.S. import demand for Canadian Pacific halibut, the Canadian supply of Pacific halibut to the United States, and an exvessel price for British Columbia halibut. In total, there were three structural equations and three market-clearing identities:

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[12] Much of this discussion is taken liberally (often verbatim) from the article Herrmann, Mark. "Estimating the Induced Price Increase for Canadian Pacific Halibut with the Introduction of the Individual Vessel Quota Program." *Canadian Journal of Agricultural Economics*. 44 (1996) pp. 151-164.

(1) $QIC^D = f_1(USPIR, USINCRC, BCSEAS, AKPEXVR)$

(2) $QI^S = f_2(BCLAND, BCPIR)$

(3) $BCPEXV = f_3(BCPI, FRIC)$

(4) $QIC^D = QI^S/USPOP$

(5) BCPIR = ((USPIR*UPPIFOOD)*EXCH)/BPPIFOOD

(6) BCPI = BCPIR*BPPIFOOD

where AKPEXVR is the real exvessel price of Alaska Pacific halibut ($/kg); BCLAND is the British Columbia landings of Pacific halibut (kg); BCPEXV is the exvessel price of British Columbia Pacific halibut (C$/kg); BCPI is the price of Canadian Pacific halibut exported to the United States (C$/kg); BCPIR is the real price of Canadian Pacific halibut exported to the United States (C$/kg); BCSEAS is the Pacific halibut season length in area 2B, is the BPPIFOOD is the British Columbia Producer Price Index for food and beverages, EXCH is the Canadian/U. S. exchange rate (C$/$); FRIC is the ratio of the previous year's exvessel price to the previous year's export price, QIC^D is the per capita import quantity of Canadian-landed halibut demanded by the United States (kg); QI^S is the per capita export quantity of Canadian-landed halibut supplied to the United States (kg); UPPIFOOD is the U.S. Producer Price Index for food and farm products, USINCRC is the real per capita personal income in the United States (billions of $); USPIR is the real imported price of Canadian halibut in the United States ($/kg); USPOP is the U.S. population.

As in the Lin model season length was included as a demand shifter (in the import demand function) to account for the period of time that British Columbia halibut could be sold fresh and to account for other advantages of a longer fishing season. This, in turn, nets the effect of IVQs on price out of the quantity-price relationship. Ideally, there could be other variables included as well, such as cost variables, inventories, and alternative market prices, such as domestic Canadian wholesale or retail prices (see Herrmann (1996) for discussion on attempts at alternative model attempts). The exvessel price (BCPEXV) was modeled as a function of the price that Canadian exporters receive for Pacific halibut (BCPI) (see Homans 1993), with changes in the year-to-year price tempered by the level of the ratio of the previous year's exvessel price to the previous year's export price (FRIC). The processor's exvessel price offers are known to the fishers at the time of delivery, but the fishers generally have little bargaining power. To the extent that fishers may have some ability to seek alternative processors, there may be a limited ability to affect their prices.

Generally, especially in the shorter seasons, fishers receive price offers from a limited choice of options and can be considered basically price takers. FRIC (short for friction) is formed by dividing the previous year's negotiated exvessel price by the previous year's export price. If the portion of the previous year's export price received by fishers was large, then all else being equal, the current year's portion of the export price will be relatively large as well. In other words, if the export price in the current year declines, there will be some drag in the decline of the nominal exvessel price, with the force of the drag depending on the size of the proportion of the previous year's exvessel price to the previous year's import price. This reflects the fact that, although fishers are mostly price takers, there is a historical relationship between fisher and buyer that affects the price offer. This relationship might be expected to increase in the post-IVQ years, as processors will need to cultivate loyal fishers to maintain their supply of halibut.

The equations were estimated using three-stage least-squares using data from 1974-1994. All equations were estimated in the linear functional form to allow elasticities to vary with both price and quantity. Only the import demand and exvessel price equation are reported below.

Equation for the U.S. import demand equation for Canadian Pacific halibut (Herrmann 96)

Dependent variable: U.S. imports of Pacific halibut (QIC^D)

Variable	Estimated Coefficient	T-Ratio	Mean-Level Elasticity
Import Price (USPIR)	-403.27	-2.28	-1.68
Income (USINCRC)	134, 680	4.02	1.84
Season Length (BCSEAS)	0.024466	2.60	0.21
Alaska Exvessel Price (AKPEXVR)	363.19	2.30	1.07
Constant (C)	-4.3745	-1.38	

$R^2 = 0.66$

DW = 1.88

The U.S. import demand equation suggests that the mean-level import demand own-price elasticity is -1.68 for Pacific halibut imported from Canada for 1974 to 1994 (price flexibility of –0.59). The own-price elasticity is higher than the long-run own-price elasticity of -1.16 (price flexibility of –0.86) for U.S. wholesale halibut that Homans (1993) found, although the modeled time period is quite different. In addition, Homan's study was on U.S. halibut, whereas this study is on British Columbia landed halibut. Because the Alaska catch is so much larger than that of British Columbia, a substitute product for the British Columbia halibut is more widely available. This would be expected to lead to a higher own-price elasticity of demand. The season length variable indicates that as the Canadian season length is increased by 1%, the demand for imported Alaska halibut increases by 0.21%, all else remaining equal. Manipulating the demand equation to yield a price flexibility with respect to season length indicates that a 1% increase in season length, at the mean, increases the import price by 12.6%, all else remaining equal. This is similar to the exvessel price flexibility with respect to season length of 15% found by Lin et al. (1988).

Equation for the Canadian Pacific halibut exvessel price (Herrmann 96)

Dependent variable: Exvessel price (BCPEXV)

Variable	Estimated Coefficient	T-Ratio	Mean-Level Elasticity
Export price (BCPI)	0.91173	24.42	1.07
Friction (FRIC)	1.8287	2.501	0.38
Constant (C)	-1.8565	-2.664	

$R^2 = 0.96$

D.W. = 1.69

Because the exvessel price is modeled as a mark-down equation a direct exvessel own-price flexibility cannot be determined from this equation. And since the equations are part of a system it is not straightforward to determine the own-price exvessel flexibility of demand. However, the interactions between landings and price can be done through dynamic simulations where the equations are solved simultaneously and then simulated for differing levels of harvest. However, since this paper focused on British Columbia the simulations were not performed for the purpose of discussing halibut landings on U.S revenues.

The importance of this paper to the discussion on the price-quantity effects of halibut landings, prices, and revenues is two-fold. The first is that there are indeed many shifters of demand that are significant over the past several years. One important shift is season length. Using a season length shifter can also account for the revenue effects induced by the individual quotas. (the model estimated that the B.C. IVQ system has increased the exvessel price received by British Columbia Pacific halibut fishers by C$1.70 per kilogram (from 1991-1994) over what it would have been without IVQs.) The second important point, made by Lin (1988), is that the system should be modeled in a system of equations, where possible, to avoid simultaneous equation bias.

Herrmann (1999)

In an extension of Herrmann (1996), this working papers examines the British Columbia IVQ price-induced effects, after Alaska introduced their IFQ program, from 1995 to 1998 and quantifies how much of the previous price-induced IVQ increases remained after Alaska went to IFQs. Results indicate that approximately one-half of the price advantage of the British Columbia IVQ system was lost after Alaska went to IFQs. However, a substantial revenue advantaged remained with the revenues estimated to have been C$16.1 million higher during 1995-1998 than if both the British Columbia and Alaska had not put the individual quota programs in place. This brings the estimated total eight-year British Columbia Pacific halibut revenue increase, due to IVQs at C$39.5 million.

Knapp (1997).

Part of the work in Knapp (1997) is dedicated to attempting to measure the effects of the Alaska halibut ITQ program by quantifying specifyied exvessel price-quantity relationships. At the wholesale level Knapp distinguished between frozen halibut, non-IFQ fresh halibut (fresh halibut prior to 1995 for Alaska and 1991 for B.C.), pre 1995 IFQ fresh halibut (B.C. only) and post-1995 IFQ fresh halibut (B.C. and Alaska). Using price and quantity points Knapp attempted to estimate three demand equations by using the equation P = f(Q) over the period 1987-1995. Only one of these was used (R^2 = 0.36) and the other two equations were drawn by hand to give a “visual best fit” as the author did not believe that the estimated demand curve was steep enough. This is most likely because the functional form P=f(Q) was not identified and was attributing the post- quota years shift in demand to the quantity slope coefficient thus biasing the slope coefficient and leading one to believe that price is less sensitive to quantity than it really is (see extensive discussion on this above). The slopes in Knapp’s estimated, and hand-drawn equations, indicate that the price of frozen halibut will decline by 2.55 cents for each million pound increase in frozen halibut and that the price fresh halibut will decline by 2 cents for each million pound increase in fresh halibut. It is difficult, from this work, and without knowing more about the factors that go into production of fresh and frozen halibut (supply factors), to determine a relationship between exvessel prices and the current halibut landing levels.

Discussion

Because of the rapid and significant structural changes to the halibut industry, and because of data limitations, it is very difficult to assess the current relationship between exvessel price and quantity. In particular, both the individual quota programs in British Columbia and Alaska have been estimated to have raised exvessel revenues in those countries (Herrmann 1996 and Knapp 1997). It is likely that over this relative short period that market adjustments, resulting from these quota periods, are not yet fully realized. Further complicating the ability to quantify current market conditions is the fact that, at the same time the U.S. quota program was being put in place, landings were being significantly decreased (1995-1996) and then significantly increased (1997-1998). As an estimation problem it becomes very difficult to sort out the effects of the changing harvest levels during the quota programs when the time period is so short and data is limited to just a few observations.

Because the demand curve for halibut has likely shifted out with the individual quota program, past measurements of the price-quantity relationships projected to the current time period are less likely to be accurate than would otherwise be the case. In all cases, with the exceptions of the Homans (1996) study, researchers were finding price flexibility to be lower than 1 (in absolute values) indicating that the market could absorb increases in commercial harvests without a decline in revenues. However, this was at lower harvest levels than recent harvests and during the non-individual quota period. Currently there are two opposing forces on the market. The higher current harvests may make the market less likely to be able to absorb any further increases in landings in the short-run[13]. However, at the same time, the market is benefiting from the longer seasons due to individual quotas which increases demand.

Again, viewing table 7 shows that it is difficult to make a clear judgement on quantity-price. Looking at the average of the 1995-1996 to the 1997-98 time period it does seem like the market

[13] In the LR higher level of landings and the resulting lower prices could result in some market expansion.

can absorb more halibut. However, this is assuming that the market adjustment (as witnessed by the rapid inventory accumulation in 1997 and then decumulation in 1998) in 1997 and 1998 somehow gives a representententative quantity-price relationship. The current 1999 season is too new to receive accurate average prices however prices do seem to have rebounded somewhat from 1998 levels despite a slight increase in quota.

The New Lin Model

In the following analysis an attempt is made to improve and expand the reduced form inverse demand equation as put forth by Lin et al. (1988). Although a simultaneous equations approach would have been preferred the data requirements, given the relatively short time period observed under the new market structures, are prohibitive. A reduced form inverse exvessel demand equation should include all the demand factors that effect the primary demand and the cost factors that affect the relationship between wholesale and retail prices. The cost factors are generally the most difficult variables to quantify because processors are generally hesitant, or unwilling, to give up proprietary data. From here on out the Lin et al. (1988) model will be called the "Original Lin" model. The new equation specification and estimation, based on the original Lin model, will be called the "New Lin" model. The Original Lin specification for their best estimation was P = f(Lan, Days, CS, PPIfish) where P is the real exvessel price of North American (combined U.S. and British Columbia) landed Pacific halibut ($/lbs.), Lan is the North American landings of Pacific halibut, Days is the season length of halibut management area 3A, CS is the beginning cold storage of frozen dressed halibut, and PPIfish is the real producer[14] index of finfish. Lin used the producer price index (PPI)[15] to transform the nominal prices to "real" prices. It should be noted that the market variables are U.S. variables and that not all of the North American halibut are consumed in the U.S. However, the majority of the North American landed halibut are consumed in the U.S[16]. Additionally, for the portion that is consumed in Canada the U.S. price indices will

[14] Lin called this the *wholesale* price index of finfish. The prior use of "wholesale" price indices have been replaced by the "producer" price indices by the Bureau of Labor Statistics.

[15] The article does not state specifically what PPI was used for deflation purposes. I assumed that it was the general PPI index for all commodities.

[16] Herrmann (1996) reports that "From 1974 to 1994, British Columbia annual landings of Pacific halibut averaged 3.3 million kilograms (dressed weight), with exports to the United States averaging 2.29 million kilograms, or 69 percent of the landings. The annual percentage of British Columbia Pacific halibut exported to the United States varied, usually between 50 and 80%. Annual landings of Pacific halibut from Alaska averaged 16.4 million kilograms, and British Columbia exports to the United States made up slightly over 12% of the U.S. market during this time. After the introduction of the British Columbia IVQ

not be too far off the Canadian price indices. Lin et al. used the estimation period from 1955 to 1984 (30 annual observations) and estimated the model using the Box-Cox flexible functional form econometric technique.

Changes in the New Lin model from the Original Lin model

I made five main modifications on the Original Lin model (and estimation) in designing the New Lin model. The new specification is

P = f(Lan, Days, ΔCS, Fuel, PPImeat)

where P is the real exvessel price of North American (United States and British Columbia) landed Pacific halibut ($/lbs.), Lan is the North American landings of Pacific halibut, Days is the season length of halibut management area 3A, ΔCS is the change in cold storage of frozen dressed halibut during the year, Fuel is the real producer price index of fuel, and PPImeat is the real producer index of meat.

1) The first modification was the estimation period. Using 1955 to 1984 gave the Original Lin model a lot annual observations (30) which is desirable from an efficiency standpoint. However, this time period goes very far back and that there would be many potential structural changes that could not be captured in the estimation of the reduced form inverse demand curve. The start of the modeling period was moved ahead to 1976 to coincide with the passage of the Magnuson Fishery Conservation and Management Act which resulted in the introduction of many changes in the U.S regulatory structure for fisheries[17]. The estimation period for the New Lin model is from 1976 to 1998 giving 23 annual observations.

2) The PPI for finfish, used as a substitute good for halibut in the Original Lin model, was replaced with a more general PPI for meat (PPImeat). There is no overwhelming statistical evidence in the literature of any particular fish species, or class of fish species, that might substitute for halibut and the use of a more general meat category will include more potential substitutes such as fish as well as other meats. Given that halibut is one of the least "fishy" tasting fish it is likely that possible market substitutes for it range well outside of the normal fish products.

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program, the exports to the United States approached 90% of total British Columbia landings, and the market share rose to nearly 14%."

3) The PPI index for fuel (PPIfuel) was added to the equation. There are many costs to processors besides the raw fish including labor, energy, and the costs of capital. The PPI for fuel was included as a general approximation for energy costs. It would be expected that as cost to processors rise the amount that they are willing to pay for the raw fish would diminish as processors need to at least cover costs to stay in the processing business. This variable may also serve as a gross proxy for transportation costs. (Attempts to include a representative transportation cost directly, as well as a labor costs, were not successful. The prime interest rate was also included in the original specification but was not statistically significant.)

4) The fourth modification was to deflate fish prices by the PPI for food and feeds instead of the PPI for all commodities as in the Original Lin model. The reason for this is that the PPI for foods and feeds more closely represents the prices for competing processor goods than a general price index.

5) The last modification is that the change in inventories for a given year were used instead of the year's beginning inventories. The problem with using the beginning inventories, as was used in the Original Lin model, is that the price-quantity relationships may be impossible to sort out as the actual halibut going to the markets is not specified. A good example was in 1997 when the exvessel prices were likely much higher than they would have been had frozen dressed halibut inventories not increased by eight million pounds. The original Lin model would not capture this as there is nothing in the equation that indicates a reduction in the total available market supply from landings. By using the change in inventories, the model will allow prices to stay higher than otherwise predicted when inventories accumulate and to decline more than otherwise predicted when inventories decumulate. However, this specification introduces an endogenous right-hand-side variable as inventory changes are somewhat determined by demand and supply forces. Estimation of equations with endogenous right-hand side variables lead to biased parameter estimates. However, in this case, to the extent that the exvessel price equation can be viewed as

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[17] Homans identifies the latest (pre-quota) period of halibut regulatory management as starting around 1978. See Homans (1993) for a comprehensive discussion of the history of the halibut regulatory structure).

recursive[18] the resulting parameter estimates are unbiased (Kennedy 1998). In any case, in the future as more data becomes available, an attempt at modeling a set of simultaneous equations would be warranted. However, from initial modeling attempts made here and by Knapp (1997), it is evident that quite a bit more data needs to be generated and collected. Finally, using changes in inventory will result in more accurate predictions of future price-quantity relationships if inventory changes are relatively constant (somewhat exogenous to the effects of price) as is the case using the averages of 1995-96 and 1997-98. Therefore, although using right-hand-side inventory changes might be unrealistic for year-to-year movements it may be more accurate for quantity-price relationships averaged a few years where inventory levels are more determined by the need to carry-over product between fishing seasons than for speculation purposes.

The New Lin Model Estimation. The New Lin equation (Table 9) was estimated with ordinary least squares using a linear functional form using the econometric package SHAZAM (White 1997). The linear functional form was used to allow for the own-price flexibilities to change for different harvest levels. The original Lin model was estimated using a Box-Cox flexible functional form. (The New Lin equation was also originally estimated using a Box-Cox flexible functional form but the two estimations were virtually identical. In the New Lin model the Box-Cox estimation yielded a $l = 0.80$. A l close to 1.0 produces a linear functional form so, for ease of use, the linear function form substituted for Box-Cox.)

Table 9. Estimation Results of the New Lin Equation

Dependent variable: Real exvessel price (P)			
Variable	Estimated Coefficient	One-Sided P-Value	Mean-Level Flexibility
Landings (Lan)	-0.12774E-09	0.000	-0.430
Days (3A)	0.12247E-04	0.030	0.048
PPIfuel (Fuel)	-0.21059E-01	0.000	-1.094
PPImeat	0.45737E-01	0.009	3.132
Cold Storage Change (ΔCS)	0.27425E-09	0.003	0.001
Constant (C)	-0.93734E-02		
$R^2 = 0.81$			
D.W. = 2.30			

[18] The fishermen have very little power to affect halibut price negotiations and can be viewed primarily as price takers. To the extent that fishermen are price takers the exvessel price equation can be thought to be recursive. This is the way that Lin originally modeled the equation as well as all other researchers listed in this paper.

The New Lin inverse exvessel demand equation's variables are all of the correct signs and significant at the standard 95% level (a = 0.05) that many economist use as a benchmark to declare statistical significance. The model's R^2 is 0.81 indicating that the variation in the modeled explanatory variables explained 81 percent of the variation in the real exvessel price of halibut. The reported flexibilities are for mean-level values of the right-hand side variables from 1976 to 1998. They indicate that the own-price flexibility is –0.43. This is much higher (in absolute terms) than found by in the Original Lin model probably indicating that the halibut market has become increasingly saturated during the period of 1976-1998 in relation to the 1955 to 1984 period when industry-wide landings were much smaller. (The New Lin model indicates that a one-percent increase in landings will reduce exvessel prices by 0.43% while the Original Lin model indicates that the same increase would decrease exvessel prices by 0.18%.).

The Original Lin model found that a one-percent increase in the season length would increase exvessel price by 0.15%. The Herrmann (1996) model, for the Canadian exvessel price, found that a 1-percent increase in the Canadian season length would increase price by 0.13%. The estimation for the New Lin model finds less sensitivity of prices to increases in season length. The New Lin finds that a 1% increase in season length will increase exvessel price by 0.05%. The fuel variable reflects that processors are able to pass off a portion of cost increases to the fishermen. However, not too much should be made of the value of the flexibility since the Fuel variable is only a gross approximation to only a portion of the processing, or transportation, costs and included to primarily to identify the demand curve. The positive change in the inventory variable indicates that prices will be higher (lower), than otherwise expected given current landings, as more (less) of the product is left in inventory than the previous year. The price-flexibility for meat indicates that a 1-percent increase (decrease) in the price of meat will increase (decrease) the exvessel price of halibut by 3.12 percent. This cross-price flexibility may seem large but the amount of total meat consumed in the U.S. is much larger than the amount of halibut consumed. As with the original Lin specification an attempt was made to include an income variable in the equation but the variable was found to be insignificant as in the original equation.

Figure 8 shows the actual and predicted (simulated) prices of North American Pacific halibut from the New Lin model.

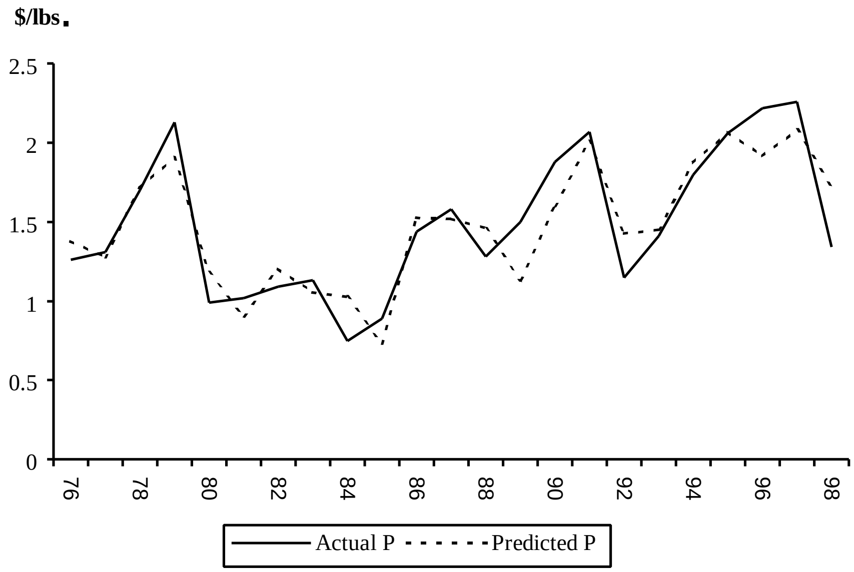

Figure 8. Actual and predicted weighted average North American Pacific halibut prices from 1976 to 1998 ($/lbs.).

Visual inspection of Figure 8 shows that the predicted and actual prices track pretty well. Further statistical validation can be found from the goodness-of-fit statistics, using the statistical package SAS (1999), and are reported own in Table 4.

Table 9. North American Pacific Halibut Goodness-of-Fit Statistics (1976-1998)

Corr	Mean ABS % Error	RMS % Error	Bias (UM)	Reg (UR)	Dist (UD)	Theil U_2
0.90	11.96	15.19	0.009	0.000	0.991	0.124

These statistics indicate that the model generally performed well in simulating actual conditions. The correlation between the actual and predicted price is 0.90. The mean absolute error and the root-mean-squared error are reasonable. Examination of the Theil inequality coefficients indicates that nearly all of the variation between actual and predicted prices is due to unpredictable error.

The Theil-U statistic (U_2) indicates that the model's predictive accuracy far exceeds a "no change" forecast[19].

Discussion

The results of the New Lin model indicate that, for a one-million pound increase in the combined North American landings of halibut, that the combined North America exvessel price will decline by 1.34 cents. The 95% confidence interval on the quantity induced price change is between 1.06 and 1.63 cents (per pound). The 1998 point own-price flexibility (for a combine harvest of 66.7 million pounds) is -0.574. This would indicate that there is still some room for the commercial halibut landings to increase before the market is fully saturated. The 95% confidence interval on the price-flexibility is between -0.434 and –0.850.

The demand curve, based on 1998 attributes, is shown in figure 9.

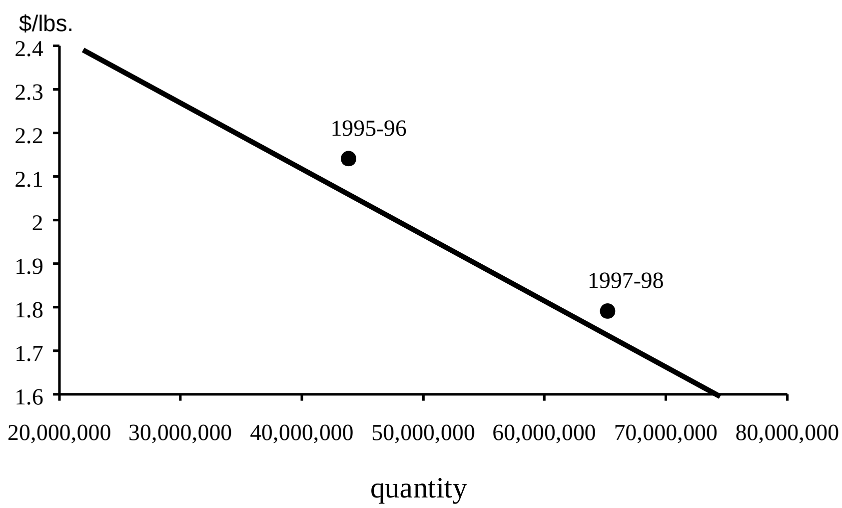

Figure 9. The New Lin inverse exvessel demand curve based on 1998 market attributes and the actual prices for 1995-96 and 1997-98.

[19] A model that does not improve on forecasting the following years price, beyond using the current years price, would yield a U_2 of 1.0. A perfect forecast would yield a U_2 statistic of 0.

Although, there would be different positioned demand curves for each year, the 1998 demand curve is plotted next to the average prices for 1995-96 and 1997-98. This demand curve predicts the price change between these two periods fairly well. It does not do as well for the individual years of 1997 and 1998 where inventories show a rapid accumulation in 1997 then decumulation in 1998 (back down to the 1995-96 levels). As stated before, because of the way that inventories are introduced in the exvessel demand equation, this model will predict much more accurately over periods where inventories remain stable. In the future, an advancement to the Homans (1993) inventory model, to include the changing inventory structure after the introduction of the individual quotas, would be welcomed.

The New Lin model would predict that the static saturation point (again defined as the point where any additional harvest will decrease revenues) would not be reached until a combined harvest of approximately 92.5 million pounds, all other variables held at their 1998 levels. This would be would be approximately a 46% increase over current harvest levels (see figure 10).

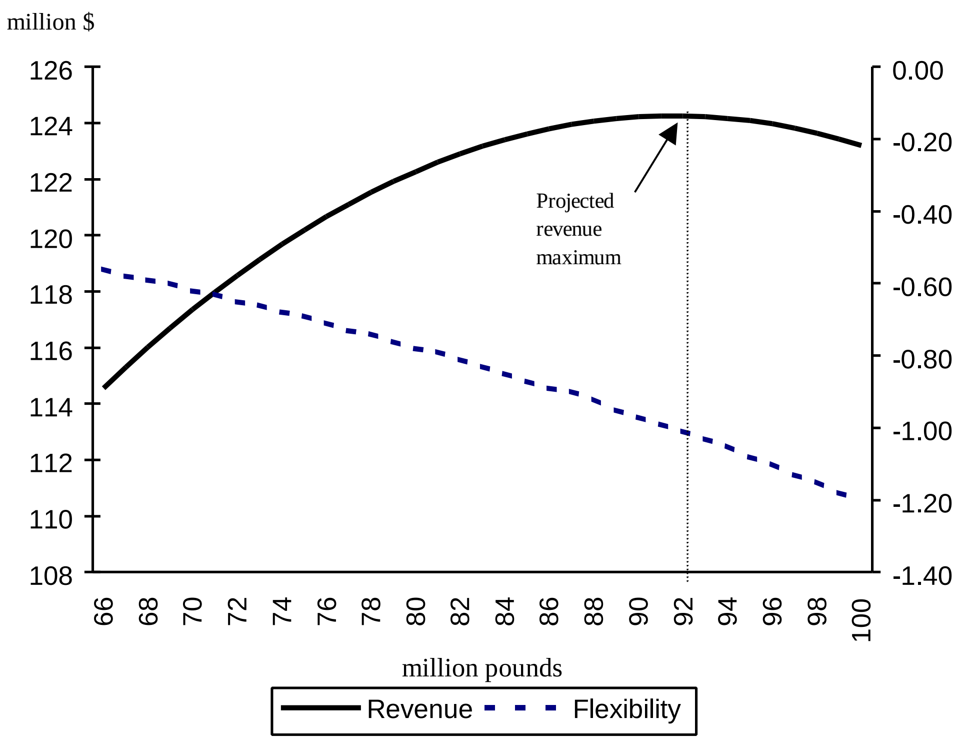

Figure 10. Estimated revenue curve and own-price flexibilities (based on 1998 market conditions) for North American Pacific halibut.

Of course, even if it could be determined that the peak in harvest, as far as revenues were concerned, were close to 90 million pounds, optimal harvest could only be determined by considering the dynamic nature of this years harvests on next years biomass etc. The New Lin model is purely a static model that indicates that, given current market conditions, increases in halibut quota may lead to increases in revenues for a given year. It says nothing about the effect on subsequent years harvests[20] and revenues and therefore cannot be used to determine optimal harvest levels. Additionally, harvesting up to the point of maximum revenue is usually not economically sound given that the marginal costs of harvesting, at the point where marginal revenue is quite low, may exceed marginal revenue. Finally, as in any static analysis, there is a great deal of uncertainty as to the actual relationship between price and quantity. The 95% confidence interval on price level, using 1998 market conditions, is 56 cents. This means that the resulting actual price can only be stated to fall within 56 cents above and below the predicted price 95% of the time. A 95% confident interval on the harvest level, that would give a one-year revenue maximum, falls between 73 and 110 million pounds. Early indications in 1999 are that prices have rebounded despite a slight increase in quota (set at 74 million pounds). However, given that the structural changes to the halibut industry are rapid and significant, and that all of these results are based on current conditions which are estimated on just a few observations, they should be used with discretion.

Need for Future Work

In the future a more sophisticated market model of the North American Pacific Halibut industry should be undertaken. However, this could take a significant amount of time and money. It would also take some cooperation of the processing industry. Data requirements would be significant, at the very minimum an expansion of the data gathered in Knapp (1997). It would be desirable to estimate a system of equations and to dynamically simulate market conditions. The simultaneous supply and demand equations might include allocations of, and demand for, halibut into the frozen and fresh domestic and export markets (at least at the wholesale level), inventory

[20] While the 1999 quota was set at 71.8 million pounds, IPHC biologist recommended a quota of 86 million. IPHC deputy director, Steve Hoag, indicated that the 86 million pound harvest was actually conservative and that the quota could have been set as high as 100 million pounds. However, due to fears over a glutted market, and a stressed stock, the commission rejected the higher quotas (Pacific Fishing 1999).

equations, and exvessel equations for both the United States and British Columbia separately. More work needs to be done on the effect of season length and a functional form might be examined that models the marginal price effect of season length as declining. It may be advisable to hold off on starting this type of ambitious modeling effort until more time has passed and more data is available. Alternatively, a researcher may want to switch to using monthly, or quarterly, data but data collection in this case would be difficult at best. Obviously, the data, time, and monetary requirement to build and estimate a more realistic simultaneous system must be weighed against the potential benefits of more accurate quantification of the marketplace.

References

Casey, K, E., C. M. Dewees, B. R. Turris, and J.E. Wilen. 1995. The effects of individual vessel quotas in the British Columbia halibut fishery. *Marine Resource Economics*. 10(3): 211-230.

Criddle, K. R. 1993. A bioeconomic analysis of the Pacific halibut industry. *Proceedings of the Fourth International Symposium of the Conference of Asian and Pan-Pacific University Presidents*, Anchorage, Alaska.

Cook B. A. and P. Copes. 1987. Optimal levels for Canada's Pacific halibut catch. *Marine Resource Economics*. 4: 45-61.

Herrmann, Mark. **1996.** "Estimating the Induced Price Increase for Canadian Pacific Halibut with the Introduction of the Individual Vessel Quota Program." *Canadian Journal of Agricultural Economics*. 44: 151-164.

Herrmann, Mark. 1999. "The Individual Vessel Quota Price Induced Effects for Canadian Pacific Halibut: An Issue Revisited" Submitted to the *Canadian Journal of Agricultural Economics*. October 1999.

Homans, F. R. 1993. *Modeling Regulated Open Access Resource Use.* Doctoral Dissertation. University of California at Davis.

Kennedy, Peter. 1998. *A Guide to Econometrics.* The MIT Press, Cambridge Massachusetts, p.468.

Knapp, Gunnar. 1997. *Alaska Halibut Markets and the Alaska Halibut IGQ Program.* Final report for Saltonstall-Kennedy Program (grant # NA37Fdo184), Anchorage, Alaska.

Lin, B. H., H. S. Richards, and J. M. Terry. 1988. An analysis of the exvessel demand for Pacific halibut. *Marine Resource Economics*. 4: 305-314.

Schellberg, T. 1993. The problem of nonmalleable capital revisited: A study of the Pacific halibut fishery. *Natural Resource Modelling*. 7(3): 245-277.

Wilen J. E. and F. R. Homans. 1994. Marketing losses in regulated open access fisheries. *Proceedings of the Sixth Conference of the International Institute of Fisheries Economics and Trade.* Ed. M. Antona, J. Catanzano, and J. G. Sutinen. Paris, France

Table 2A.3—Primary purpose of visit to Alaska for Kenai Peninsula saltwater halibut and salmon anglers from the Lee et al. (1999) by *Kenai days*.

	Alaskans (less locals)	Non-Residents
Fishing on Kenai main reason	80.0%	34.1%
Visit/Vacation Alaska	5.4%	25.6%
Kenai Freshwater fish	1.6%	14.5%
Relatives	7.2%	19.7%
Business	1.7%	2.6%
Saltwater/freshwater fishing	0.4%	1.9%
Visit Friends	3.8%	0.6%
Cruise Ship	0.0%	0.4%
Hunting	0.0%	0.5%

Again, the assumptions made in the main report (Table 3.21) are used to calculate the percent of the days spent on the Kenai, and in other parts of Alaska, due to the fishing trip. So, for example, non-residents whose main purpose of the trip was to visit relatives made up 11.2% of the total *trips* but 19.2% of the *total days spent on the Kenai*. This is presumably due longer visits to the Kenai for non-residents visiting relatives than for those making a trip just to fish. Table 2A.4 summarizes our assumptions as to the effects on a trip when the Kenai saltwater fishing portion is canceled by trip purpose.

Table 2A.4—Assumed Effects of the cancellation of the saltwater fishing portion of the Kenai trip on days spent on the Kenai.

Main Purpose of Trip	**All Fishers**
Saltwater Fishing on Kenai	Cancel Kenai Trip
Visit/Vacation in Alaska (non-Kenai focus)	Cancel Kenai Trip
Visit Relatives	Still take full trip
Freshwater Fishing on Kenai	Reduce Kenai days by amount of days lost saltwater fishing
Business Trip	Still take full trip
Combined Saltwater/freshwater fishing	Reduce days spent in Kenai by amount of days lost saltwater fishing
Visit Friends	Still take full trip
Cruise Ship	Still take full trip
Hunting	Still take full trip

The assumptions in Table 2A.4 result in the following percentages of the trip due to the fishing component as reported in Table 2A.5.

Table 2A.5—Assumed Net Effects of the cancellation of the saltwater fishing portion of the Kenai trip on days applied to Appendix 2A.3.

Main Purpose of Trip	Kenai Portion
Saltwater Fishing on Kenai	100%
Visit/Vacation in Alaska (non-Kenai focus)	100%
Visit Relatives	0%
Freshwater Fishing on Kenai	AK (ratio1)% Non-res (ratio2)%
Business Trip	0%
Combined Saltwater/freshwater fishing	AK (ratio3)% Non-res (ratio4)%
Visit Friends	0%
Cruise Ship	0%
Hunting	0%

Where

ratio1 = days spent saltwater fishing to days spent on the Kenai by Alaskans whose primary trip purpose was freshwater fishing on the Kenai (51.0%)

ratio3 = days spent saltwater fishing fishing to days on the Kenai by non-residents whose primary trip purpose was freshwater fishing on the Kenai (17.9%)

ratio5 = days spent saltwater fishing fishing to days spent on the Kenai by Alaskans whose primary trip purpose was combined saltwater/freshwater fishing on the Kenai (33.3%)

ratio7 = days spent saltwater fishing fishing to days spent on the Kenai by non-residents whose primary trip purpose was combined saltwater/freshwater fishing on the Kenai (40.0%).

Table 2A.6 is a reproduction of Table 3.22

Table 2A.6—Estimated reduction in visitation rates for a 100% reduction in fishing effort (days).

	Locals	Alaskans	Non-Residents
Fishing Reduction	100%	100%	100%
Kenai Living Reduction	100%	89.1%	64.0%
Alaska Living Reduction (net Kenai)	100%	79.3%	32.7%

For illustration the estimated reduction in non-residents fishing days (64.0%) is calculated below. The 64.0% figure is interpreted as 64.0% of the total days spent on the Kenai Peninsula having been directly due to the Kenai saltwater fishing component of the trip. Therefore, when a fishing trip is reduced 1 day, 0.64 days spent on the Kenai Peninsula will be lost.

Non-resident Kenai living reduction = 34.1% + 25.6% + (17.9 %)*(19.7%)+ (40.0%)*(1.9%) = 64.0%

likewise

Resident Kenai living reduction = 80.0% + 5.4% +(51.1%)*(7.2%) + (33.3%)*(0.4%) = 89.1%

Again, calculations for the Alaska living reduction numbers are done likewise although the Alaska living reductions are likely to change.

Executive Summary

This report summarizes survey data that was gathered to describe the Pacific halibut and salmon sport fisheries in marine waters off the Kenai Peninsula, Alaska. All data were collected through a mail survey. The sample of anglers surveyed was drawn from the set of U.S. residents who purchased an Alaska State sport-fishing license in 1997. A total of 2,640 completed, or partially completed, surveys were returned from a sample of 4,000 anglers, for an overall response rate of 70.1%, based on delivered surveys.

The proportion of Alaskan resident respondents who sport fished in marine waters off the Kenai Peninsula in 1997 is 34.5%, while the corresponding proportion for non-resident respondents is 35.5%. The majority of Alaskan respondents (80.9%) indicated that the main purpose of their Kenai trip was saltwater sport fishing, whereas less than half of the non-resident respondents (41.7%) reported saltwater fishing as the main purpose of their trip. Trips where only halibut were targeted (halibut-only trips) accounted for 40.9% of all trips. King salmon-only trips, silver salmon-only trips, and trips where both halibut and salmon were targeted each accounted for approximately 18-22% of the trips. In general, Alaskan respondents took more frequent and longer trips than non-Alaskans. Alaskans taking halibut-only trips also averaged more total days (4.2 days) than non-Alaskans (2.0 days). However, Alaskans' average catch per day (1.69 halibut) was less than that of non-Alaskans (2.04 halibut). These general patterns were also true for king salmon-only trips, silver salmon-only trips, and combination trips where both halibut and salmon were targeted.

The main port of departure for the most recent reported Kenai Peninsula saltwater fishing trip was Homer (45.2%), followed by Seward (31.5%), Deep Creek/Ninilchik (29.5%), and Kenai (12.5%). In all cases use of charter services was the most common means of fishing with 61.2% of the non-residents and 40.4% of the residents reporting that they used a charter service on their most recent trip. Trips that employed charter services accounted for 51.6% of all reported trips. Non-Alaskans spent more per day in all major trip-related expense categories than Alaskans. Non-residents reported daily traveling and living expenditures of $101 while Alaskans reported daily traveling and living expenditures of $44. Non-residents reported daily fishing expenditures of $138, while Alaskans reported daily fishing expenditures of $47.

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Appendix A: List of Tables

Introduction

The commercial and sport fisheries for Pacific halibut in the waters off Alaska's Kenai Peninsula each contribute to the economic well being of Kenai Peninsula residents, Alaska state residents, and the nation as a whole. However, while the economics of the commercial fishery have been subject to considerable analysis, the economic value of the sport fishery has not been carefully examined.

The numbers of halibut charter boats and their catch share have increased in recent years. In response to concerns raised by commercial fishers, the North Pacific Fishery Management Council and the Alaska Department of Fish and Game are considering entry moratorium/license limitation on vessels authorized to offer halibut charter services; or, annual catch limits for individual sport fishermen. Implementation of either of these policy alternatives will affect the magnitude and distribution of net benefits from sport fishing.

This report summarizes survey data that was gathered to describe the Pacific halibut and marine (saltwater) salmon sport fisheries off the Kenai Peninsula, Alaska. All data were collected through a mail survey. The sample of anglers surveyed was drawn from all those who purchased an Alaska State sport fishing license in 1997. Consequently, the sample includes individuals who did not fish off the Kenai. All respondents were asked general questions regarding their fishing activities in Alaska during 1997 and several socioeconomic questions. Anglers who sport fished in marine waters off the Kenai Peninsula during 1997 were asked to provide additional information regarding the number of trips taken and total catch during 1997. Respondents who had taken a Kenai trip during the previous five years were asked to supply detailed information about their most recent trip.

The results are presented in five sections (labeled I-V). An effort has been made throughout the report to provide data summary information for all respondents as well as a comparison of Alaskan and non-Alaskan respondents. Section I addresses the number of mailings and response rates. Section II presents the socioeconomic data gathered. These data include age, gender, education, number of household members and household income. Section III summarizes the 1997 general fishing activities of respondents. These include the number of days fished in Alaska, whether the respondent fished for Pacific halibut or saltwater salmon in Alaska, and the number of days in each of those activities. Section IV summarizes respondents' 1997 marine sport fishing activity off the Kenai Peninsula. Section V summarizes detailed trip information from the respondents' most recent marine sport fishing trip off the Kenai. These include summary information with respect to days and locations fished, species targeted, mode of fishing, species catch and size information, and respondent expenditures. The reader is cautioned to use the information presented in Section V with care since the data do not necessarily represent an average trip. Appendix A contains all survey data in tabular form. Appendix B includes an example of the survey.

An initial draft of the survey was created in the summer of 1997 for pretesting purposes. Copies of this survey were administered directly to anglers in Homer and Seward, Alaska to gauge its effectiveness. Later versions of the survey were pretested using verbal protocol analysis (Ericsson and Simon, 1993[1]). During this phase of pretesting angler attitudes and vocabulary were studied, as well as their decision making process and ability to answer the survey questions. The protocol analyses utilized individual interviews of randomly selected potential survey recipients from Fairbanks and Anchorage and were conducted in-person. Information from all pretesting stages was used to improve the content and clarity of the survey instrument, questions, format, cover design, and cover letters.

The survey sample frame is comprised of all individuals who purchased an Alaska State sport fishing license in 1997 and who have a U.S. address. Thus the survey results characterize anglers who reside in the U.S. ADF&G's 1997 Alaska State sport fishing license list of U.S. residents consists of 49.7% Alaskan resident and 50.3% non-resident. A random sample of 4,000 anglers was drawn from this list. This 4,000 angler sample was composed of 49.3% Alaskan residents and 51.7% non-residents.

The sample of 4,000 anglers is rather large compared to most economic studies of sport fishing. The large number was necessary since it was not possible to determine *a priori* which license holders had fished off the Kenai Peninsula during 1997. Information from previous ADF&G annual angler surveys suggested that approximately 30% of all license holders in a given year fish off the Kenai in that year. This implies

[1] Ericsson, K. A. and H. A. Simon, 1993. Protocol Analysis, Verbal Reports as Data. The MIT Press: Cambridge, Massachusetts.

that a mailing of 4,000 surveys with an overall response rate of 50% [2], for example, would generate 2,000 returned surveys; and, thus approximately 600 responses from anglers who had fished off the Kenai Peninsula.

The survey was developed and carried out following Dillman's Total Design Method (Dillman, 1978 [3]). Respondents received up to three survey mailings plus a thank-you/reminder after the first mailing. All sampled license holders received a survey during the first mailing, followed by a reminder card. Non-respondents were sent a second survey 14 days after the initial survey was mailed. The first two survey mailings and the reminder card were sent by first class mail. The third survey was sent by certified mail to those who did not respond within 14 days after the second survey was mailed.

All survey mailings contained a cover letter, a prize entry card (to increase the response rate), a business reply envelope, and one of eighteen versions of the survey instrument. See Appendix B for an example survey.

Section 1. Survey Mailings and Response Rates

A total of 2,640 completed, or partially completed, surveys were returned out of the initial sample of 4,000 US resident Alaska State sport fishing license holders. Two hundred thirty-three of the potential respondents were classified as "not deliverable." The vast majority of the not deliverables were due to an incorrect address in the license file with no forwarding address left with the US Postal Service. A small number of individuals were classified as not deliverable due to illness or death. Thus, 3,767 individuals received a survey in at least one of the mailings. While the overall response rate based on mailings was 66.00%, the overall response rate based on delivered surveys was 70.08% (Figure 1.1, Table A1.1).

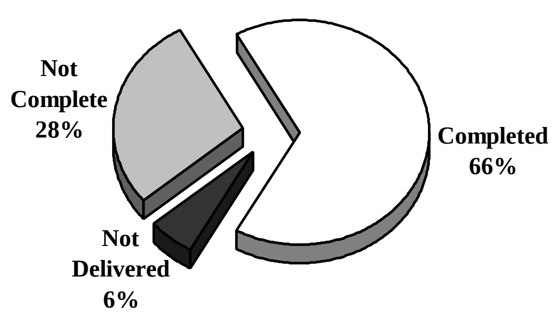

Figure 1.1. Percent of surveys mailed and returned, mailed and not returned, and non-deliverables.

[2] The ADF&G angler survey achieves about a 50% response rate.
[3] Dillman, D. A., 1978. Mail and Telephone Surveys. John Wiley & Sons: New York.

The overall response rate based on delivered surveys is 70.08% (Table A1.1). Table A1-2 lists the response rate by mailing. The response rate to the first mailing was 45.88%. The response rate to the second and third mailings were nearly identical, 25.42% and 25.37% respectfully. Both follow-up mailings contributed significantly to the relatively high overall response rate.

One might expect that individuals who participated in the marine sport fishery off the Kenai Peninsula would be more likely to respond to the survey. One way to measure this is to examine the responses to a question that asked whether the respondent had fished off the Kenai in the last five years. A total number of 1,163 respondents had fished off the Kenai in the last five years and 1,477 had not. The vast majority of respondents who had fished off the Kenai (70.9%) responded to the first mailing whereas only 62.4% of the respondents who had not fished off the Kenai responded on the first mailing (Table A1.3.)

The response rates of Alaskan and non-residents were 63.39% and 76.42%, respectively (Table A1.4). However, percentage of resident vs. non-resident returns are quite similar to the proportion of resident and non-resident Alaska sports fishers reported in the annual Alaska Department of Fish and Game (ADF&G) Alaska sport fish survey (Figure 1.2).[4]

(From here on, the Kenai Angler sports fish survey will be referred to as the "UAF" study and the ADF&G annual sport fish survey will be referred to as the "ADF&G" study).

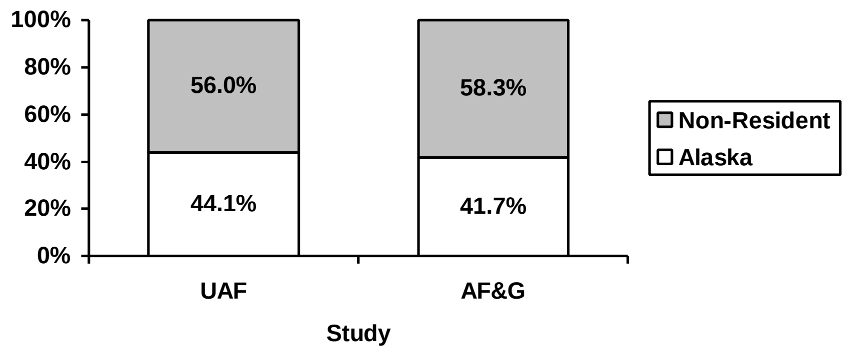

Figure 1.2. Percentage of resident vs. non-resident surveys returned for the UAF Kenai Peninsula marine sports fish survey and the percentage of Alaska fishing licenses sold as reported by the ADF&G sports fish survey.

The sample proportion of those who had sport fished off the Kenai during 1997, the sample frame license year, was nearly identical between Alaskan and Non-Alaskan respondents (Table A1.6). The proportion

[4] Alaska Department of Fish and Game. *Harvest, Catch, and Participation in Alaska Sport Fisheries During 1997.* Division of Sports Fish. Fishery Data Series No. 98-25.

of Alaskan residents who fished in saltwater off the Kenai in 1997 is 34.51%, while the corresponding proportion for non-residents is 35.52% (Figure 1.3). The ADF&G survey corresponds to ours with 35.7% of all license holders reported fishing Kenai saltwater in 1997. Table A1-7 shows these same proportions by mailing.

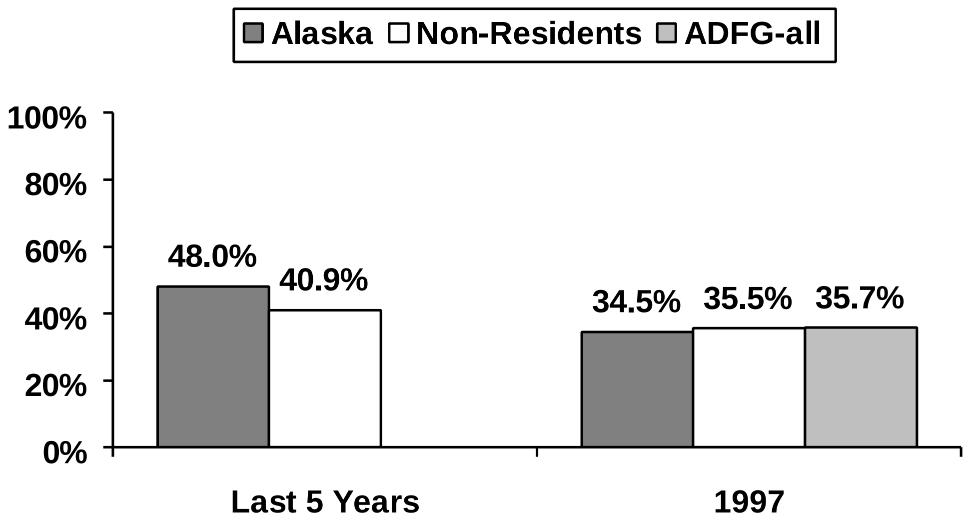

Figure 1.3. Percentage of resident and non-resident respondents who sport fished in marine waters off the Kenai Peninsula in the last five years and in 1997.

Section II. Socioeconomic Characteristics of Respondents

The survey collected several socioeconomic variables from respondents. The variables include age, gender, education level, number of household members, and income. Figure 2.1 (Table A2.1) shows the distribution of the age of respondents. The largest group of Alaskans (31.4%) was 40-49 years of age. The largest group of non-residents (26.7%) was over 60 years of age. The mean age of Alaskans who responded is 42.5 years, and the mean age of non-Alaskans is 49.3 years (Table A2.6).

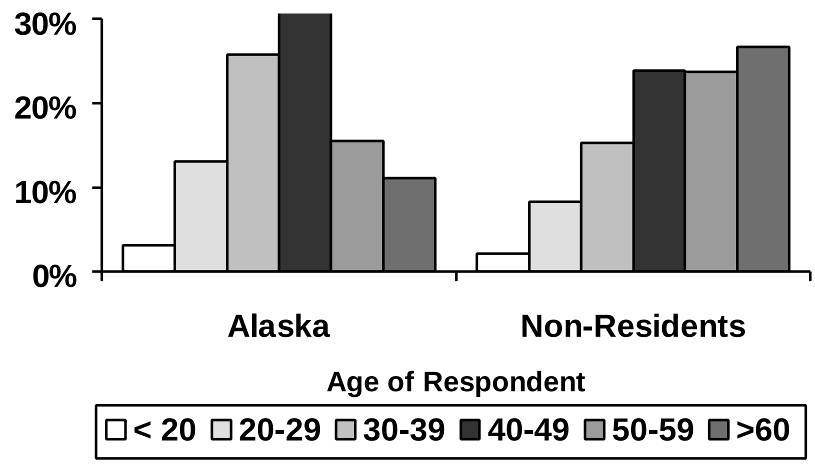

Figure 2.1. Age distribution of respondents.

Figure 2.2 (Table A2.2) shows the gender distribution of the full sample, and that for Alaskans and the non-Alaskans. Overall, 72.9% of those who responded are male. Smaller proportions of the Alaskan respondents are male (65.6%) compared to the non-Alaskan respondents (78.6%).

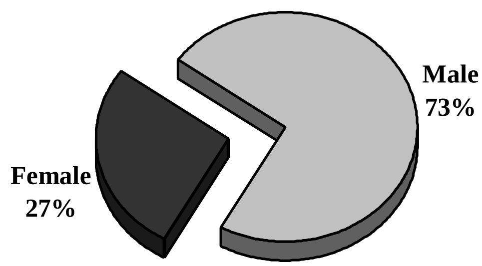

Figure 2.2. Gender distribution of respondents.

The distribution of the highest education level attained by respondents is reported in appendix table A2.3. College graduate (or higher) was the largest category for both Alaskans and non-Alaskans. However, fewer Alaskans reported they were college graduates (35.7%) than non-Alaskans (50.6%). Figure 2.3 shows the education distribution for all respondents.

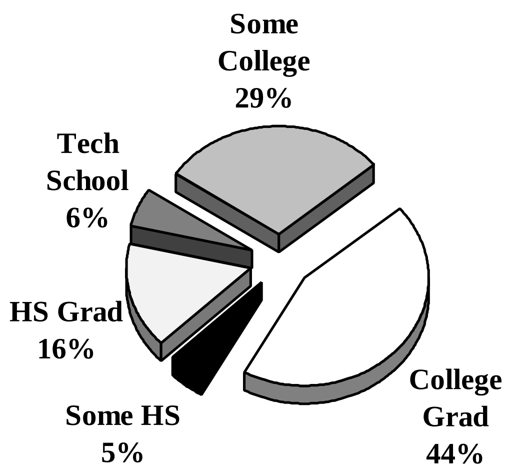

Figure 2.3. Education level.

Table A2.4 reports the distributions of number of household members. The most frequently observed household size of both Alaskan (35.7%) and non-Alaskan residents (49.1%) is 2 household members. The distribution of household income for all respondents, Alaskans and non-Alaskans, is given in Table A2.5. Respondents were asked to circle an income category containing their total 1997, after-tax, household income. Overall, Alaskans reported lower household income levels than non-Alaskans. The median category for Alaskans is $40,000-$59,000, while the median category for non-Alaskans is $60,000 to $79,999. The average age level, number of household members and estimated after-tax annual income is shown in Table 2.1.

Table 2.1. Summary statistics of respondents' age, household size and after-tax income.

	Mean Age	Mean Household Size	Mean Income
All Respondents	46.31	2.85	$66,355
Alaskan	42.52	3.01	$57,453
Non-Alaskan	49.28	2.73	$73,268

* Household income summary statistics are based on the midpoints of the income categories given in Table 2-5. A value 120,000 was used for the 'Over $100,000' category.

Section III. General 1997 Alaska Fishing Activity

Tables A3.1 – A3.4 contain information regarding respondents' general fishing activity in Alaska during 1997. These include the total number of days spent sport fishing in Alaska, and the number of days spent Pacific halibut or saltwater salmon fishing in Alaska. All questions in this section regarding the number of days fished were categorical questions. The categories are presented in the tables. As expected, Alaskans tended to fish more total days than non-Alaskans. The median category for Alaskans is 6-10 days, while the median category for non-Alaskans is 3-5 days. The largest group of Alaskans fished over 20 days (29.3%). The largest group of non-Alaskans fished 3 to 5 days (36.3%). Just over seven percent of the

Alaskans in our sample that bought fishing licenses did not fish, while only 1% of non-Alaskans who bought licenses did not fish.

Table A3.2 shows number and percent of respondents who fished for halibut or saltwater salmon anywhere in Alaska in 1997. Overall, 68.7% of all respondents participated in at least one of these fisheries. We can infer that the remainder fished freshwater only, did not fish at all, or possibly fished in marine waters for species other than halibut and salmon. A slightly lower percentage of Alaskans fished for these species (65.1%) than non-Alaskans (71.6%). Table 3.1 summarizes some of the results contained in Tables A3.1-A3.4.

Table 3.1. Total number of days respondents fished in Alaska in 1997.

	Alaska Resident			Non-Resident		
Days Fished in 1997	Fished	Fished Halibut	Fished Saltwater Salmon	Fished	Fished Halibut	Fished Saltwater Salmon
1-2	11.9%	37.0%	26.0%	30.8%	54.7%	40.8%
3-5	17.7%	23.4%	19.7%	36.3%	19.0%	24.4%
6-10	17.7%	11.6%	13.6%	22.9%	5.3%	8.7%
11-20	16.2%	7.5%	11.2%	6.2%	1.1%	1.4%
Over 20	29.3%	7.5%	11.1%	2.8%	0.6%	1.1%
Did Not Fish	7.2%	13.1%	18.5%	1.0%	19.4%	23.7%

Section IV. Fishing Activity in Saltwater off the Kenai Peninsula in 1997.

This section describes respondents' marine sport fishing activity off the Kenai Peninsula during 1997. A total of 926 respondents (35.08% of all respondents) fished off the Kenai during 1997 (Table A1.6). These respondents were asked the total number of trips taken, the total days fished, and total catch for four types fishing trips defined by the targeted species. The types of trips are as follows:

- Only Halibut were targeted during the trip
- Only King Salmon were targeted during the trip
- Only Silver Salmon were targeted during the trip
- Both Halibut and Salmon were targeted during the trip.

The distribution of fish species targeted by respondents is shown in Figure 4.1 (and Table A4.1). Halibut-only trips accounted for 40.9% of all trips. The remaining trips were divided nearly evenly among king salmon only, silver salmon only, and halibut/salmon combos.

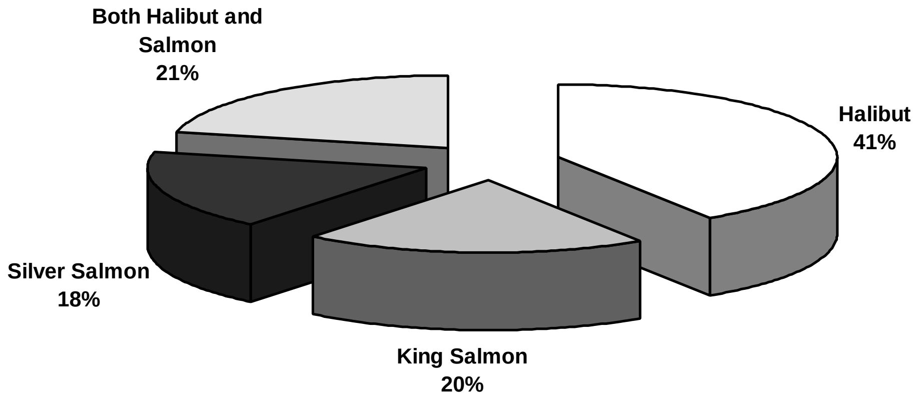

Figure 4-1. Species targeted by respondents during 1997 Kenai Peninsula saltwater sport fishing trips.

Tables A4.2 through A4.10 contain frequency tables and descriptive statistics for each type of target species trip. All of these tables are based only on those observations where the respondent took that particular type of trip. Tables A4.2 and A4.3 describe the halibut-only trips. Tables A4.4 and A4.5 describe the king salmon-only trips. Tables A4.6 and A4.7 describe the silver salmon-only trips. Tables A4.8 - A4.10 describe combination trips where both halibut and salmon were targeted.

In general, Alaskan respondents took more and longer trips than non-Alaskans. For example, among the 628 respondents who targeted halibut in 1997, the average Alaskan spent more total days on halibut only trips in 1997 (4.16 days) than non-Alaskans (2.04 days). [5] (See Figure 4-2.) However, Alaskans' average catch per day (1.69 halibut) was less than that of non-Alaskans (2.04 halibut). (See Figure 4-3.) These general patterns were also true of king salmon-only trips, silver salmon-only trips, and trips where both halibut and salmon were targeted.

[5] The estimated average days fished in this survey exceed the estimates reported from the ADF&G angler survey. This difference is the only major inconsistency in the results of the two surveys and is under further investigation.

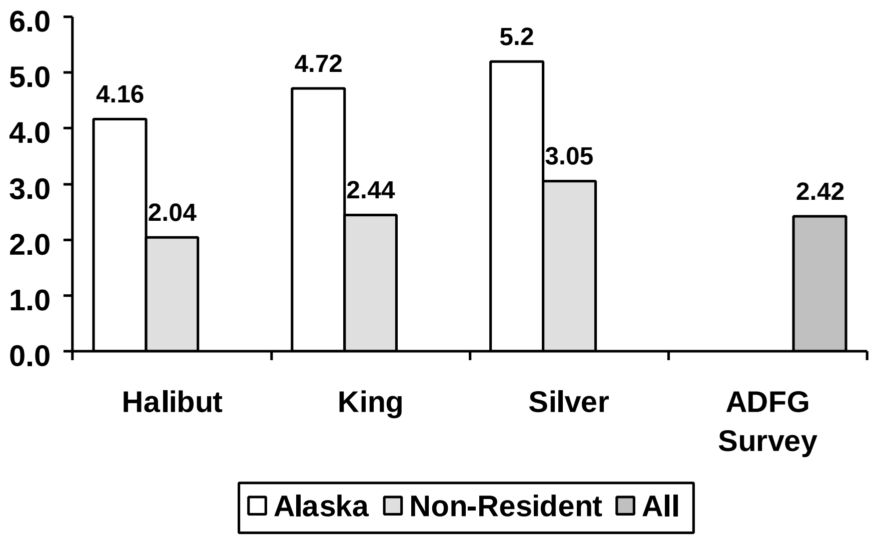

Figure 4.2. Average days fished by respondents who fished at least one day off the Kenai Peninsula in 1997. (The ADF&G survey does not provide separate results by target species.)

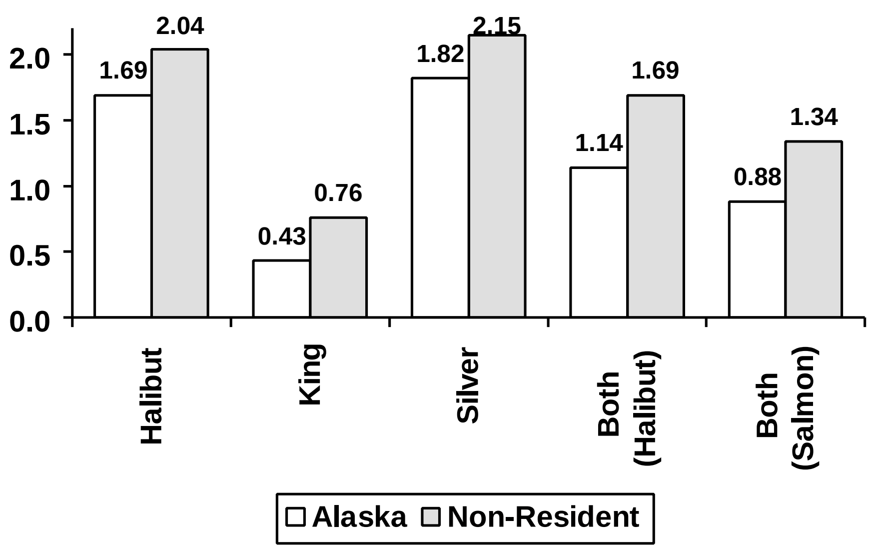

Figure 4.3. Catch per day for 1997 Kenai Peninsula fishing trips.

The larger average daily catch for non-residents can be explained, in part, by the larger percentage of non-residents who take chartered trips with professional guides as opposed to fishing from their own vessels or fishing shoreline. This will be further discussed in section V where detailed results on the fishermen's most recent trips are examined.

The estimated average daily catches can be compared with averages reported from the ADF&G sportsfish survey. ADF&G catches are not reported by whether the trip was targeted or not and includes trips for species of fish other than halibut or salmon. Therefore one would expect their 1997 reported daily averages, averaged across all types of trips, to be less than the averages reported for the targeted trips. For instance, Figure 4-4 shows that our study finds that the daily average catch for all Kenai fishermen when halibut was the targeted trip was 1.77 and 1.36 when both salmon and halibut was targeted. ADF&G reports that the average halibut catch was 1.21 when any type of fish was targeted. As most targeted Kenai trips are for halibut or salmon (although some are for other species, including rockfish and lingcod) we would expect the ADF&G daily average halibut catch to be slightly below the daily halibut catch average that we found for the combined salmon and halibut trip and this is the case. Therefore, for average catch, there is consistency between the two surveys.

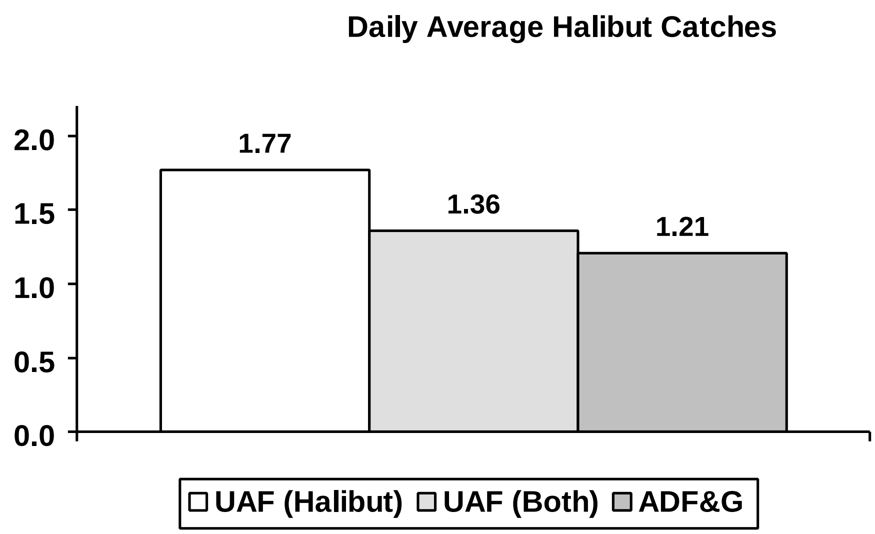

Figure 4.4. Average daily halibut catches from the UAF Kenai study when halibut or a combination of halibut and salmon were targeted, and from the ADF&G study.

Section V. Detailed Description of Most Recent Kenai Marine Sport Fishing Trip

Respondents who had taken a marine sport fishing trip to the Kenai Peninsula in the last five years were asked to provide detailed information about their most recent trip. This data was gathered to assist in the statistical analysis of another part of the project that is not addressed in this report. A complete set of tables is found in Appendix A Tables A5.1 – A5.15. The value of this information is that it provides a great deal of detail regarding anglers' fishing activity and expenditures. However, the reader is cautioned that the data do not necessarily represent average trips because respondents were only queried about their most recent trip.

Overall, 44.1% of the respondents took a marine sport fishing trip to the Kenai Peninsula in the last five years (Table A1.5). Alaskans participated at a higher rate (48.0%) than non-Alaskans (40.9%). Figure 5.1

and Tables A5.1 and A5.2 show the distribution of the month and year in which the most recent trip occurred.

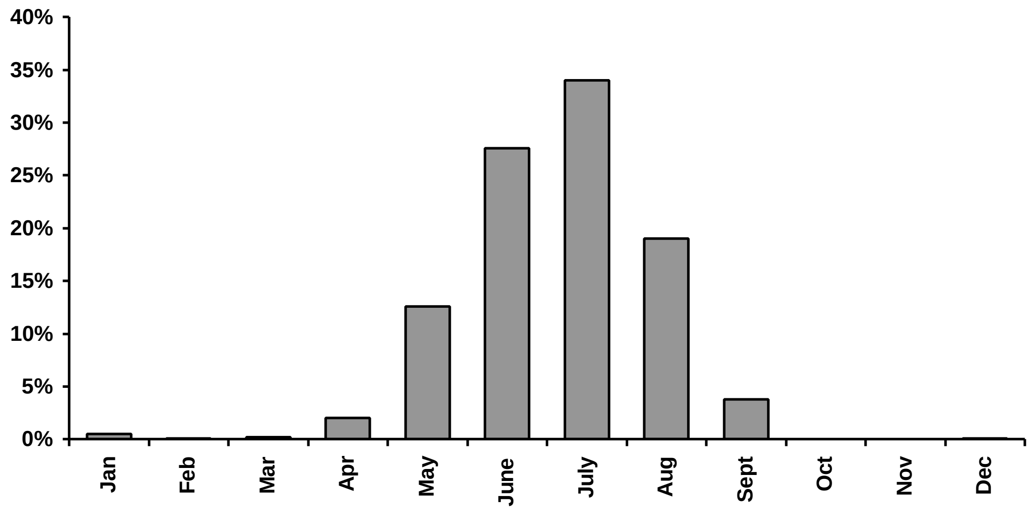

Figure 5.1 Month in which respondents started their most recent trip.

Most of the reported trips fell between May and August. The most common month in which most recent trips started was July (34.0%). Note that we would expect the percentages to be skewed toward later months since we asked about most recent trips. The majority of respondents' most recent trip occurred in 1997 (71.7%) with 84.3% of these trips occurring within the last 2 years. Tables A5.3 and A5.4 contain information regarding the primary purpose of respondents' most recent trip. Saltwater sport fishing was the primary purpose for the most recent trip for 80.9% of Alaskans but only 41.75% of non-Alaskans. For those respondents whose primary purpose was not saltwater sport fishing, the most frequent purposes given were to: 1) visit/vacation in Alaska (38.3%); 2) visit relatives (22.4%); and, 3) freshwater sport fish on the Kenai Peninsula (19.8%).

The distributions of locations where respondents fished (or launched their boat [6]) and fishing mode are presented in Appendix A Tables A5.5 – A5.6. Homer was the most frequent location (45.2%), with Seward (31.5%) and Deep Creek/ Ninilchik (29.5%) the next most frequent choices. These percentages total more than 100% because they include trips that visited multiple sites. Figure 5.2 shows the percentage of trips weighted when the totals are divided by the total reported trips whether they were multiple trips or not.

[6] For instance, many of the fishermen fishing the Barren Islands launched from Homer.

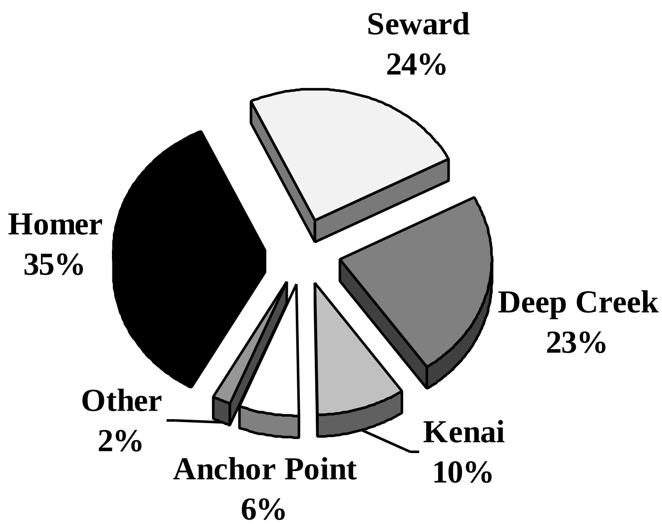

Figure 5.2. Location of the respondent's most recent Kenai saltwater fishing trip.

For Tables A5.7 and A5.8 respondents were asked which mode(s) of fishing was used during their most recent trip (charter, private boat, shorebased). The majority of respondents hired charter services (Figure 5.3). However, Alaskans and non-Alaskans differ in their usage of guide/charter services. While most non-Alaskans used charters on their most recent trips, Alaskans were nearly equally likely to have used charters and private boats. Few respondents among either group took trips that included shorebased fishing compared to the other modes, probably an indication that Kenai Peninsula marine fisheries are not well suited to shorebased fishing.

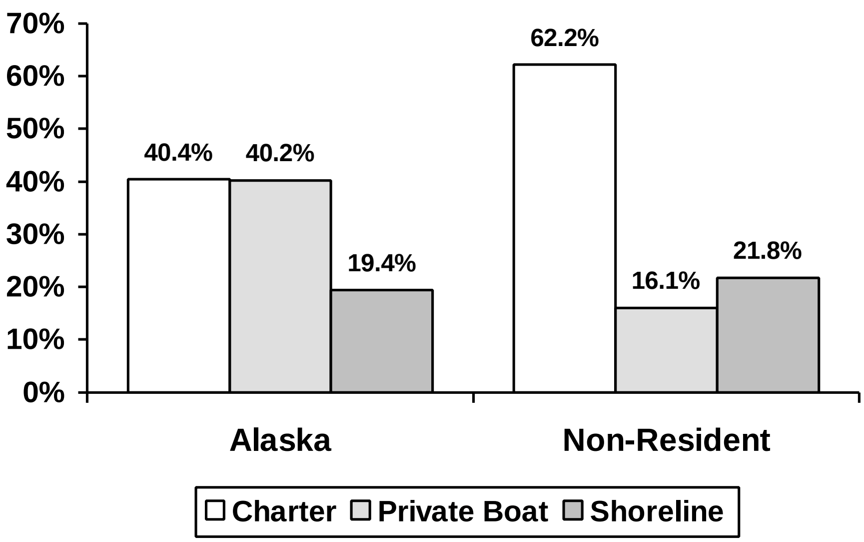

Figure 5.3. Frequency of fishing mode (charter, private boat, and shore trips).

The distribution of species targeted is given in Table 5.1 below (and Tables A5.9-A5.12). Halibut was the most frequently targeted species (targeted by 83.1% of all Kenai saltwater fishermen). In Homer halibut was targeted by 92.2% of all fishermen. King salmon was the next most frequently targeted saltwater species targeted by 36.7% overall but by over 50% of respondents from Deep Creek/Ninilchik.

Table 5-1. Species targeted by respondents on their most recent trip .*

Species Targeted	All Areas	Homer	Seward	Deep Creek/Ninilchik
Halibut	83.1%	92.2%	72.1%	92.6%
King Salmon	36.7%	35.3%	27.6%	50.4%
Silver Salmon	25.5%	23.9%	52.7%	18.1%

* Many respondents targeted more than one species on a trip.

Detailed fish catch, keep, release, and size information is given by species in Table A5.13 – A5.15. The information in these tables is based on observations from all respondents who provided any catch information. The average daily catches differ by whether the trip was targeted or not. Figure 5.4 shows the average daily catch for the most recent trip if taken in the last five years.

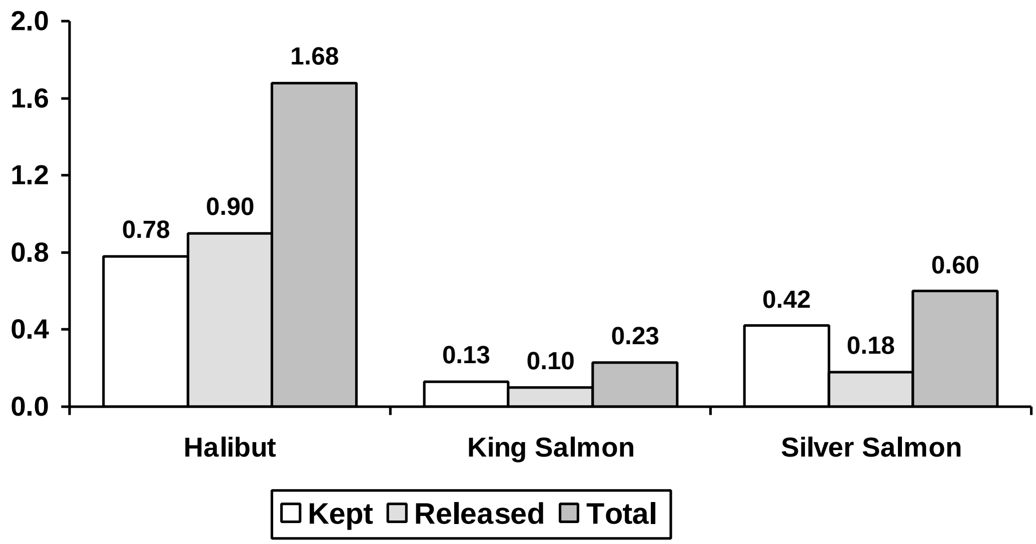

Figure 5.4. Most recent Kenai saltwater fishing trip (kept per day, released per day, and total catch per day) where either salmon or halibut were targeted.

The average daily catch of halibut was 1.74 fish with the average keep of 0.79 fish. The average daily catch of king salmon was 0.23 fish and 0.53 fish for silver.

When examining halibut the numbers found in this survey are pretty consistent with the annual ADF&G survey (Figure 5.5). Again, the differences between these two surveys is probably attributable to the fact that our survey targeted only those fishermen that targeted either salmon or halibut whereas the ADF&G survey asked catch statistics of fishermen targeting any species. Therefore, one would expect our numbers to be somewhat higher.

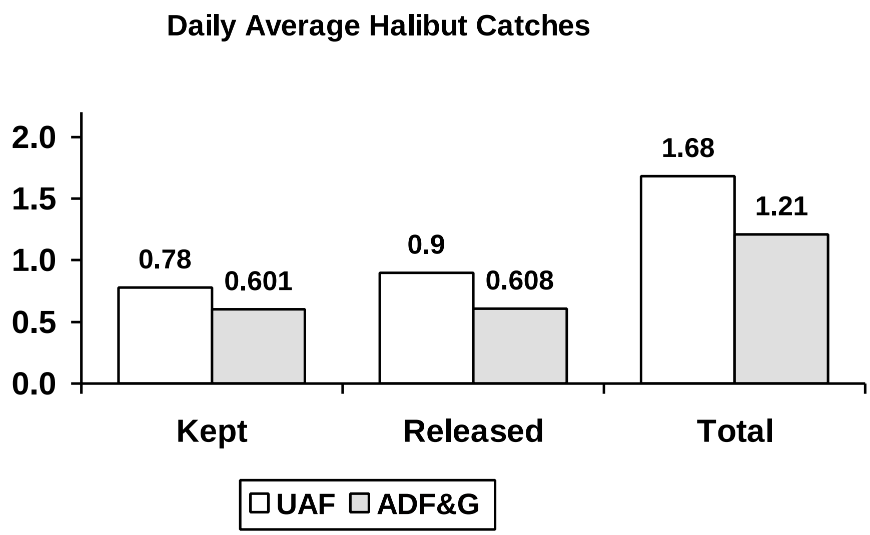

Figure 5.5. Halibut catch per day, kept per day, and released per day from UAF and ADF&G surveys.

When the particular species is the target the catch reported numbers rise substantially (see figure 5.6). For instance, the daily average catch on the last Kenai trip taken is 0.23 king salmon but when king salmon are targeted that number doubles to 0.46.

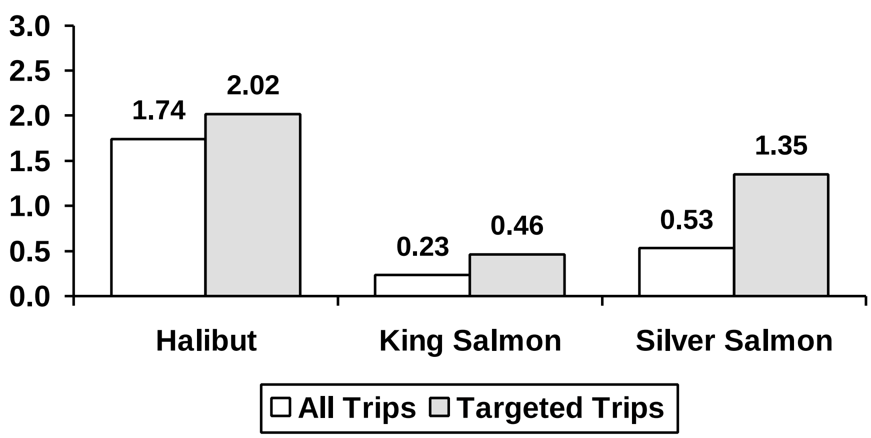

Figure 5.6. Most recent Kenai saltwater fishing trip daily average catch where either salmon or halibut were targeted (all trips) and where each individual particular species was targeted.

Table 5.2 shows the average weight reported for each species caught for any type of trip (Also see Table A5-14).

Table 5.2. Most recent Kenai fishing trip average weights

Species Targeted	Average of last 5-years (1997)	Most Recent 5-Year Trip (pounds)	1997 (pounds)
Halibut	681 (486)	36.93	38.33
King Salmon	180 (121)	29.68	29.40
Silver Salmon	163 (129)	9.46	9.20
Other Salmon	98 (68)	7.22	7.29

We asked respondents to provide detailed information regarding their expenditures on their most recent trips. Appendix Table A5.15 reports the average fishing and non-fishing expenditures for Kenai saltwater fishermen. The average daily expenditures for the fishermen are weighted by days spent on the Kenai for the non-fishing expenditures and by fishing days for the fishing expenditures. The average living expenditures are also weighted on all days spent on the trip (both fishing and non-fishing).

Table 5.3. Average daily expenditures for marine sportfishing trips off the Kenai Peninsula. ($)

	Kenai Peninsula residents	Other Alaska residents	Non-residents	Total	All Alaska residents
Observations	54	288	404	746	342
Auto or truck fuel	5.75	12.84	7.50	8.78	11.08
Auto or RV rental fees	3.53	1.30	13.73	9.49	1.86
Airfare	0.00	1.60	33.18	21.77	1.20
Other transportation	0.39	0.91	2.10	1.63	0.78
Total transportation expenditures	9.67	16.65	56.51	41.66	14.91
Lodging (trailer parks, campgrounds, hotels/motels)	2.71	10.85	23.51	18.27	8.83
Groceries	6.00	13.54	10.07	10.64	11.67
Restaurant and bar	5.33	10.18	10.42	9.91	8.97
Total food and lodging expenditures	14.04	34.58	44.01	38.82	29.46
Total transportation and lodging expenditures	23.70	51.23	100.51	80.48	44.38
Charter and guide fees (including tips)	8.38	31.86	97.46	60.56	24.57
Fishing gear (purchased only for trip)	3.04	5.20	15.02	9.71	4.53
Processing	1.10	2.39	19.41	10.59	1.99
Derby	0.94	0.67	1.00	0.87	0.75
Boat fuel and repairs	13.52	11.01	4.31	8.10	11.79
Haulout and moorage fees	4.10	2.52	1.07	2.05	3.01
Total fishing expenditures	31.07	53.65	138.27	91.88	46.65
Other expenditures	0.00	0.24	4.84	3.17	0.18
Total of all expenditures on a non-fishing day*	23.70	51.23	100.51	80.48	44.38
Total of all expenditures on a fishing day**	54.77	105.12	243.62	175.53	91.20

* Total transportation and lodging expenditures (calculated by dividing per day trip expenditures (all days spent on trip) by days spent on the Kenai Peninsula).
** The sum of the total of all expenditures plus other expenditures plus total fishing expenditures.

As one would expect the expenditures rise the further one is away from the Kenai. For the local residents (living on the Kenai Peninsula) total transportation and living expenditures are only $23.70 per day. Transportation and living expenses from non-local Alaska residents averaged $51.23 per day and from non-residents $100.51 per day. This may slightly overestimate actual non-living expenses in the Kenai as it is unclear how much of the Auto and RV rentals and the airfare expenses end up in the Kenai Peninsula.

For fishing expenditures locals spent an average of $31.07 per day while non-local Alaskans spent $53.65 per day and non-residents $138.27 per day. The reported total daily expenditures are the combination of the transportation and living for the non-fishing days and all of the expenditures for the fishing days (see Figure 5.7).

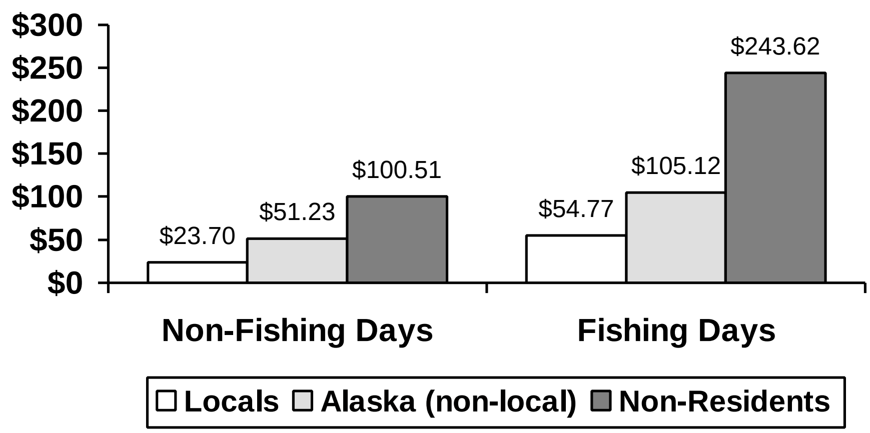

Figure 5.7. Average daily expenditures for fishing and non-fishing days by locals, Alaskans (non-locals) and non-residents for the most recent Kenai Peninsula saltwater fishing trip in the last five years.

The numbers in Table 5.3 are averaged across all respondents whether that respondent actually made an expenditure or not. In other words, the average charter expenditure for non-residents is $97.46. However only 62.2% of the trips taken by non-residents were chartered. Therefore, the average values are also averaged over 37.8% of the respondents who did not take an average trip. Table 5.4 reports average daily expenditures only for those respondents who actually recorded an expense in a particular category.

Table 5-4. Average daily expenditures for respondents reporting a positive expenditure. ($)

	Alaskan	Other US	Total
Auto or Truck Fuel	12.89	11.63	12.16
Auto or RV Rental Fees	33.35	41.49	40.79
Airfare	41.49	56.75	56.34
Other Transportation	18.96	50.40	46.09
Lodging (trailer parks, campgrounds, hotels/motels)	19.19	33.17	29.47
Groceries	14.31	11.50	12.46
Restaurant and Bar	14.09	12.45	12.93
Charter and Guide Fees (including tips)	70.97	134.05	113.35
Fishing Gear (Purchased only for trip)	9.42	27.92	19.06
Processing	9.97	35.67	28.64
Derby	3.10	5.21	4.02
Boat fuel and Repairs	29.25	31.45	29.80
Haul out and Moorage Fees	14.08	14.48	14.18

Appendix A. Results in Tabular Form.

Table A1.1. Number of surveys mailed, deliverable, not deliverable, and survey response rate.

Survey outcomes	Number of people	Percent of total sample (4,000)	Percent of delivered (3,767)
Sample size	4,000	100.00%	
Number not deliverable	233	5.83%	
Number deliverable	3,767	94.17%	100.00%
Number completed	2,640	66.00%	70.08%

Table A1.2. Survey response rate by first, second and third mailing.

Mailing	Number mailed	Number delivered	Number completed	Response rate
First mailing	4,000	3,808	1,747	45.88%
Second mailing	2,055	2,014	512	25.42%
Third mailing	1,502*	1,502*	381	25.37%

* We assume that all of the surveys mailed in the third mailing were delivered. Since the third mailing was by certified mail, surveys that were not picked up at the post office, refused, or had an invalid address were returned to sender. It is unlikely that surveys had invalid addresses since invalid addresses from the first two mailings were removed from the mailing list.

Table A1.3. Distribution of responses by mailing and whether the respondent had saltwater sport fished off the Kenai Peninsula in the last five years.

Mailing	Fished off Kenai	Did not fish off Kenai	Percent who fished off Kenai
	Number of responses	Number of responses	
First mailing	825	922	47.22%
Second mailing	200	312	39.06%
Third mailing	138	243	36.22%
Total	1,163	1,477	44.05%

Table A1.4. Number of surveys mailed, deliverable, not deliverable, and survey response rate.*

Survey outcomes	Alaskans			Non-Alaskans		
	Number of people	Percent of total mailed	Percent of delivered	Number of people	Percent of total mailed	Percent of delivered
Sample size	1,992	100.00%		2,008	100.00%	
Number not deliverable	159	7.98%		74	3.69%	
Number deliverable	1,833	92.02%	100.00%	1,934	96.31%	100.00%
Number completed	1,163	58.38%	63.39%	1,477	73.56%	76.42%

* It was not possible to determine the residency of 14 of the non-respondents. Their residency was allocated based on existing response rates (10 to Alaskan non-deliverables and 4 to non-Alaskan non-deliverables).

Table A1.5. Distribution of respondents who had saltwater sport fished off the Kenai Peninsula in the last five years.

	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Fished	1,163	44.05%	558	48.02%	605	40.93%
Did not fish	1,477	55.95%	604	51.98%	873	59.07%
Total	2,640	100.0%	1,162	100.0%	1,478	100.0%

Table A1.6. Distribution of respondents who had saltwater sport fished off the Kenai Peninsula in 1997.

	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Fished	926	35.08%	401	34.51%	525	35.52%
Did not fish	1,714	64.92%	761	65.49%	953	64.48%
Total	2,640	100.00%	1,162	100.00%	1,478	100.00%

Table A1.7. Distribution of responses by mailing, whether the respondent sport fished in marine waters off the Kenai Peninsula in the last five years.

		Did fish		Did not fish		Percent who fished
Residency	Mailing	Number of responses	Percent	Number of responses	Percent	
Alaskan	First mailing	377	67.6%	333	55.1%	53.1%
	Second mailing	103	18.5%	152	25.2%	40.4%
	Third mailing	79	14.0%	119	19.7%	39.9%
	Total	558	100.0%	604	100.0%	48.0%
Non-Alaskan	First mailing	448	74.0%	589	67.5%	43.2%
	Second mailing	97	16.0%	160	18.3%	37.7%
	Third mailing	60	9.9%	124	14.2%	32.6%
	Total	605	100.0%	873	100.0%	40.9%

Table A2.1. Age distribution.

	All respondents		Alaskans		Non-Alaskans	
Age	Frequency	Percent	Frequency	Percent	Frequency	Percent
Under 20	65	2.5%	35	3.1%	30	2.1%
20-29	268	10.4%	148	13.1%	120	8.3%
30-39	513	19.9%	292	25.8%	221	15.3%
40-49	700	27.2%	355	31.4%	345	23.9%
50-59	518	20.1%	176	15.5%	342	23.7%
Over 60	511	19.8%	126	11.1%	385	26.7%
Total	2,575	100.0%	1,132	100.0%	1,443	100.0%
Missing	65		30		35	

Table A2.2. Gender distribution.

Gender	All respondents Frequency	All respondents Percent	Alaskan Frequency	Alaskan Percent	Non-Alaskan Frequency	Non-Alaskan Percent
Female	699	27.1%	390	34.4%	309	21.4%
Male	1,883	72.9%	745	65.6%	1,138	78.6%
Total responses	2,582	100.0%	1,135	100.0%	1,447	100.0%
Missing	58		27		31	

Table A2.3. Education level.

Education	All respondents Frequency	All respondents Percent	Alaskans Frequency	Alaskans Percent	Non-Alaskans Frequency	Non-Alaskans Percent
Some high school	120	4.7%	68	6.0%	52	3.6%
H.S. Graduate	406	15.8%	186	16.4%	220	15.3%
Technical school	154	6.0%	79	7.0%	75	5.2%
Some college	757	29.5%	394	34.8%	363	25.2%
College graduate	1,132	44.1%	404	35.7%	728	50.6%
Total responses	2,569	100.0%	1,131	100.0%	1,438	100.0%
Missing	71		31		40	

Table A2.4. Household size.

Household size	All respondents Frequency	All respondents Percent	Alaskans Frequency	Alaskans Percent	Non-Alaskans Frequency	Non-Alaskans Percent
1	304	11.9%	138	12.3%	166	11.6%
2	1,102	43.2%	399	35.7%	703	49.1%
3	373	14.6%	199	17.8%	174	12.1%
4	438	17.2%	216	19.3%	222	15.5%
5 or more	335	13.1%	167	14.9%	168	11.7%
Total responses	2,552	100.0%	1,119	100.0%	1,433	100.0%
Missing	88		43		45	

Table A2.5. Distribution of respondents' total household income (after-tax, 1997).

Income	All respondents Frequency	All respondents Percent	Alaskans Frequency	Alaskans Percent	Non-Alaskans Frequency	Non-Alaskans Percent
Under $20,000	146	5.9%	106	9.9%	40	2.9%
$20,000 to $29,999	206	8.4%	112	10.4%	94	6.8%
$30,000 to $39,999	293	11.9%	149	13.9%	144	10.4%
$40,000 to $59,999	587	23.9%	284	26.4%	303	21.9%
$60,000 to $79,999	444	18.1%	180	16.8%	264	19.1%
$80,000 to $99,999	266	10.8%	111	10.3%	155	11.2%
Over $100,000	515	21.0%	132	12.3%	383	27.7%
Total responses	2,457	100.0%	1,074	100.0%	1,383	100.0%
Missing	183		88		95	

Table A2.6. Summary statistics of respondents' age and household size and income.

		Median	Mean	Std.dev.
Age	All respondents	46.00	46.31	14.17
	Alaskan	42.00	42.52	12.95
	Non-Alaskan	50.00	49.28	14.39
Household size	All respondents	2.00	2.85	1.50
	Alaskan	3.00	3.01	1.64
	Non-Alaskan	2.00	2.73	1.38
Household income*	All respondents	50,000	66,355	33,878
	Alaskan	50,000	57,453	31,459
	Non-Alaskan	70,000	73,268	34,156

* Household income summary statistics are based on the mid-points of the income categories given in table 2-5. A value 120,000 was used for the 'over $100,000' category.

Table A3.1. Days fished in Alaska in 1997.

	All respondents		Alaskans		Non-Alaskans	
Days fished in 1997	Frequency	Percent	Frequency	Percent	Frequency	Percent
1-2	592	22.5%	138	11.9%	454	30.8%
3-5	739	28.1%	205	17.7%	534	36.3%
6-10	542	20.6%	205	17.7%	337	22.9%
11-20	279	10.6%	188	16.2%	91	6.2%
Over 20	380	14.4%	339	29.3%	41	2.8%
Did not fish	98	3.7%	83	7.2%	15	1.0%
Total responses	2,630	100.0%	1,158	100.0%	1,472	100.0%
Missing	10		4		6	

Table A3.2. Number and percent of respondents who fished for halibut or saltwater salmon* in Alaska in 1997.

	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Fished	1,813	68.7%	756	65.1%	1,057	71.6%
Did not fish	825	31.3%	405	34.9%	420	28.4%
Total responses	2,638	100.0%	1,161	100.0%	1,477	100.0%
Missing	2		1		1	

* saltwater salmon was defined in the survey to exclude salmon caught in rivers or dipnetting in the mouth of a river.

Table A3.3. Days fished for halibut in Alaska in 1997*.

	All respondents		Alaskans		Non-Alaskans	
Days	Frequency	Percent	Frequency	Percent	Frequency	Percent
1-2	847	47.3%	277	37.0%	570	54.7%
3-5	373	20.8%	175	23.4%	198	19.0%
6-10	142	7.9%	87	11.6%	55	5.3%
11-20	67	3.7%	56	7.5%	11	1.1%
Over 20	62	3.5%	56	7.5%	6	0.6%
Did not fish	300	16.8%	98	13.1%	202	19.4%
Total responses	1,791	100.0%	749	100.0%	1,042	100.0%
Missing	24		8		16	

* Based on those who fished for halibut or saltwater salmon in 1997.

Table A3.4. Days fished for saltwater salmon in Alaska in 1997*.

	All respondents		Alaskans		Non-Alaskans	
Days	Frequency	Percent	Frequency	Percent	Frequency	Percent
1-2	618	34.6%	195	26.0%	423	40.8%
3-5	401	22.4%	148	19.7%	253	24.4%
6-10	192	10.7%	102	13.6%	90	8.7%
11-20	98	5.5%	84	11.2%	14	1.4%
Over 20	94	5.3%	83	11.1%	11	1.1%
Did not fish	385	21.5%	139	18.5%	246	23.7%
Total	1,788	100.0%	751	100.0%	1,037	100.0%
Missing	27		6		21	

* Based on those who fished for halibut or saltwater salmon in 1997.

Table A4.1. Species targeted by respondents during 1997 Kenai Peninsula saltwater sport fishing trips.

Species fished for during trip	Number of Respondents	Percent of all those reporting who took a Kenai trip in 1997 (912)
Halibut only	628	68.86%
King salmon only	306	33.55%
Silver salmon only	273	29.93%
Both halibut and salmon	330	36.18%
Total	912*	**

* the 4 trip categories add up to 1,537 trips. This breaks down to 912 people reporting 1.68 different types of trips each.
** column percent adds to more than 100% since many respondents took more than one trip.

Table A4.2. Catch per day on trips where respondents only fished for halibut .*

Catch per day**	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero	51	8.5%	29	10.2%	22	7.1%
(0,1]	97	16.2%	63	22.3%	34	10.9%
(1,2]	381	63.8%	170	60.1%	211	67.6%
(2,3]	14	2.3%	6	2.1%	8	2.6%
(3,5]	25	4.2%	8	2.8%	17	5.4%
More than 5	29	4.9%	7	2.5%	20	6.6%
Total	597	100.0%	283	100.0%	315	100.0%

* This table includes only those observations where the respondent took a halibut-only trip (i.e., A trip where only halibut were fished for during the trip).
** The symbol '(' means greater than and ']' means less than or equal to (e.g., '(0,1]' means greater than zero and less than or equal to one.)

Table A4.3. Halibut-only trip summary statistics *

Residency	Variable	Obs	Median	Mean	Std. Dev.
All respondents	Total 1997 days fished	609	2	3.04	5.15
	Total 1997 catch	607	2	5.41	9.13
	Catch per day**			1.77	
Alaskans	Total 1997 days fished	286	2	4.16	5.59
	Total 1997 catch	288	3	6.72	11.00
	Catch per day			1.69	
Non- Alaskans	Total 1997 days fished	323	1	2.04	4.51
	Total 1997 catch	319	2	4.21	6.82
	Catch per day			2.04	

* This table includes only those observations where the respondent took a halibut-only trip (i.e., A trip where only halibut were fished for during the trip).
** Catch per day is calculated by taking the total fish caught divided by the total days fished. Therefore it does not have a median or standard deviation.

Table A4.4. Catch per day on trips where respondents only fished for king salmon .*

Catch per day**	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero	116	40.6%	56	36.6%	60	45.1%
(0,1]	150	52.4%	88	57.5%	62	46.6%
(1,2]	16	5.6%	9	5.9%	7	5.3%
(2,3]	1	0.3%	0	0.0%	1	0.8%
(3,5]	0	0.0%	0	0.0%	0	0.0%
More than 5	3	1.0%	0	0.0%	3	2.3%
Total	286	100.0%	153	100.0%	133	100.0%

* This table includes only those observations where the respondent took a king salmon-only trip (i.e., a trip where only king salmon were fished for during the trip).
** The symbol '(' means greater than and ']' means less than or equal to (e.g., '(0,1]' means greater than zero and less than or equal to one.)

Table A4.5. King salmon-only trip summary statistics .*

Residency	Variable	Obs	Median	Mean	Std. Dev.
All respondents	Total 1997 days fished	299	2	3.64	4.52
	Total 1997 catch	303	1	1.91	4.81
	Catch per day**			0.53	
Alaskans	Total 1997 days fished	158	3	4.72	5.36
	Total 1997 catch	162	1	1.98	3.57
	Catch per day			0.43	
Non- Alaskans	Total 1997 days fished	141	2	2.44	2.92
	Total 1997 catch	141	1	1.84	5.94
	Catch per day			0.76	

* This table includes only those observations where the respondent took a king salmon-only trip (i.e., A trip where only king salmon were fished for during the trip).
** Catch per day is calculated by taking the total fish caught divided by the total days fished. Therefore it does not have a median or standard deviation.

Table A4.6. Catch per day on trips where respondents only fished for silver salmon .*

Catch per day**	All respondents Frequency	Percent	Alaskans Frequency	Percent	Non-Alaskans Frequency	Percent
Zero	48	19.0%	21	15.0%	27	23.9%
(0,1]	58	23.0%	39	27.9%	19	16.8%
(1,3]	84	33.3%	51	36.4%	33	29.2%
(3,6]	54	21.4%	28	20.0%	26	23.0%
(6,10]	4	1.6%	0	0.0%	4	3.5%
More than 10	4	1.6%	1	0.7%	4	3.5%
Total	252	100.0%	140	100.0%	113	100.0%

* This table includes only those observations where the respondent took a silver salmon-only trip (i.e., A trip where only silver salmon were fished for during the trip).
** The symbol '(' means greater than and ']' means less than or equal to (e.g., '(0,1]' means greater than zero and less than or equal to one.)

Table A4.7. Silver salmon-only trip summary statistics .*

Residency	Variable	Obs	Median	Mean	Std. Dev.
All respondents	Total 1997 days fished	261	2	4.23	4.82
	Total 1997 catch	266	4	8.19	15.39
	Catch per day**			1.91	
Alaskans	Total 1997 days fished	144	3	5.20	5.39
	Total 1997 catch	148	4	9.23	18.91
	Catch per day			1.82	
Non-Alaskans	Total 1997 days fished	117	2	3.05	3.68
	Total 1997 catch	118	4	6.91	9.12
	Catch per day			2.15	

* This table includes only those observations where the respondent took a silver salmon-only trip (i.e., A trip where only silver salmon were fished for during the trip).
** Catch per day is calculated by taking the total fish caught divided by the total days fished. Therefore it does not have a median or standard deviation.

Table A4.8. Halibut catch per day on combination trips .*

Halibut catch per day**	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero	30	10.2%	12	8.4%	18	11.8%
(0,1]	82	27.8%	55	38.5%	27	17.8%
(1,2]	157	53.2%	68	47.6%	89	58.6%
(2,3]	14	4.7%	5	3.5%	9	5.9%
(3,5]	10	3.4%	3	2.1%	7	4.6%
More than 5	2	0.7%	0	0.0%	2	1.3%
Total	295	100.0%	143	100.0%	152	100.0%

* This table includes only those observations where the respondent took a halibut and salmon trip (i.e., A trip where halibut and salmon were fished for during the trip).
** The symbol '(' means greater than and ']' means less than or equal to (e.g., '(0,1]' means greater than zero and less than or equal to one.)

Table A4.9. Salmon catch per day on combination trips .*

Salmon catch per day**	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Zero	92	31.2%	39	27.5%	53	34.6%
(0,1]	125	42.4%	70	49.3%	55	35.9%
(1,3]	43	14.6%	21	14.8%	22	14.4%
(3,6]	33	11.2%	12	8.5%	21	13.7%
(6,10]	2	0.7%	0	0.0%	2	1.3%
More than 10	0	0.0%	0	0.0%	0	0.0%
Total	295	100.0%	142	100.0%	153	100.0%

* This table includes only those observations where the respondent took a halibut and salmon trip (i.e., A trip where halibut and salmon were fished for during the trip).
** The symbol '(' means greater than and ']' means less than or equal to (e.g., '(0,1]' means greater than zero and less than or equal to one.)

Table A4.10. Summary statistics for combination trips where respondents targeted both halibut and saltwater salmon.*

Residency	Variable	Obs	Median	Mean	Std. Dev.
All respondents	Total days fished for halibut	310	2	3.01	3.74
	Total days fished for salmon	308	2	2.97	3.13
	Total halibut catch	314	2	4.03	5.22
	Halibut catch per day**			1.36	
	Total salmon catch	318	1	3.14	6.03
	Salmon catch per day			1.09	
Alaskans	Total days fished for halibut	151	2	3.69	4.75
	Total days fished for salmon	149	2	3.28	3.44
	Total halibut catch	153	2	4.15	5.65
	Halibut catch per day			1.14	
	Total salmon catch	153	1	2.80	5.03
	Salmon catch per day			0.88	
Non-Alaskans	Total days fished for halibut	159	2	2.35	2.26
	Total days fished for salmon	159	2	2.67	2.78
	Total halibut catch	161	2	3.91	4.78
	Halibut catch per day			1.69	
	Total salmon catch	165	1	3.45	6.84
	Salmon catch per day			1.34	

* This table includes only those observations where the respondent took a halibut and salmon trip (i.e., A trip where halibut and salmon were fished for during the trip).

** Catch per day is calculated by taking the total fish caught divided by the total days fished. Therefore it does not have a median or standard deviation.

Table A5.1. Month in which respondents started their most recent trip.

Month	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Jan.	5	0.5%	2	0.4%	3	0.6%
Feb.	1	0.1%	1	0.2%	0	0.0%
Mar.	2	0.2%	2	0.4%	0	0.0%
Apr.	19	2.0%	14	3.0%	5	1.1%
May	117	12.6%	78	16.8%	39	8.4%
June	257	27.6%	124	26.7%	133	28.5%
July	316	34.0%	139	30.0%	177	38.0%
Aug.	177	19.0%	87	18.8%	90	19.3%
Sep.	35	3.8%	17	3.7%	18	3.9%
Oct.	0	0.0%	0	0.0%	0	0.0%
Nov.	0	0.0%	0	0.0%	0	0.0%
Dec.	1	0.1%	0	0.0%	1	0.2%
Total	930	100.0%	464	100.0%	466	100.0%

Table A5.2. Years in which respondents started their most recent trip.

Year	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1992	2	0.2%	1	0.2%	1	0.2%
1993	16	1.7%	9	1.9%	7	1.5%
1994	18	1.9%	12	2.6%	6	1.3%
1995	39	4.2%	30	6.5%	9	1.9%
1996	71	7.7%	57	12.3%	14	3.0%
1997	665	71.7%	257	55.3%	408	88.1%
1998	117	12.6%	99	21.3%	18	3.9%
Total	928	100.0%	465	100.0%	463	100.0%

Table A5.3. Trip purpose.

Primary purpose	**All respondents**		**Alaskans**		**Non-Alaskans**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Marine fishing	570	61.3%	376	80.9%	194	41.7%
Other reason	360	38.7%	89	19.1%	271	58.3%

Table A5.4. 'Other' primary purposes for trips.

Primary purpose	Frequency	Percent
Visit/vacation in Alaska	130	38.3%
Visit relatives	76	22.4%
Kenai freshwater fishing	67	19.8%
Business trip	29	8.6%
Saltwater and freshwater fishing	12	3.5%
Visit friends	8	2.4%
Cruise ship vacation	7	2.1%
Hunting	4	1.2%
Vacation on Kenai	4	1.2%
Other	2	0.6%
Total number of written-in responses	339	100.0%

Table A5.5. Location(s) where respondents fished (launched) on the Kenai Peninsula during most recent trip.

	Frequency	Percent*
Homer	419	45.2%
Seward	292	31.5%
Deep Creek/Ninilchik	274	29.5%
Kenai	116	12.5%
Anchor Point	77	8.3%
Other	22	2.4%

* The percent column does not sum to 100% since several respondents used multiple launch or fishing sites during their trip.

Table A5.6. 'Other' fishing (launching) locations written-in by respondents.

	Frequency	Percent
Seldovia	10	45.5%
Whiskey Gulch	3	13.6%
Stariski	2	9.1%
McDonald Spit	1	4.5%
Port Dick	1	4.5%
Tutka Bay	1	4.5%
Unknown	4	18.2%
Total number of responses written-in by respondents	22	100.0%

Table A5.7. Location(s) launched or fished from by fishing mode (charter, private boat, and shore trips).

Location launched or fished from	Charter		Private boat		Shore	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Homer	278	42.57%	97	26.65%	69	26.44%
Seward	166	25.42%	80	21.98%	73	27.97%
Deep Creek/Ninilchik	143	21.90%	102	28.02%	39	14.94%
Kenai	38	5.82%	34	9.34%	56	21.46%
Anchor Point	22	3.37%	37	10.16%	21	8.05%
Other	6	0.92%	14	3.85%	3	1.15%
Total	653	100.00%	364	100.00%	261	100.00%

Table A5.8. Fishing mode (charter, private boat, and shore trips) by Alaska residents and non-residents for Homer, Seward, Deep Creek/Ninilchik, Kenai, and Anchor Point.

	Alaska resident		Non-resident		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Charter	244	40.40%	403	62.19%	647	51.68%
Private boat	243	40.23%	104	16.05%	347	27.72%
Shoreline	117	19.37%	141	21.76%	258	20.61%
Total	604	100.0%	648	100.0%	1252	100.0%

Table A5.9. Species targeted by respondents on their most recent trip*.

Species targeted	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Halibut	771	83.1%	380	81.7%	291	84.4%
King salmon	341	36.7%	163	35.1%	178	38.4%
Silver salmon	237	25.5%	118	25.4%	119	25.7%
Other salmon	210	22.6%	49	10.5%	81	17.5%

* Percentages are out of the total number of respondents who targeted any species.

Table A5.10. Species targeted by respondents whose most recent trip included Homer .*

Species targeted	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Halibut	377	92.4%	176	92.6%	201	92.2%
King salmon	135	33.1%	58	30.5%	77	35.3%
Silver salmon	83	20.3%	31	16.3%	52	23.9%
Other salmon	62	15.2%	20	10.5%	42	19.3%

* Percentages are out of the total number of respondents who targeted any species at this location.

Table A5.11. Species targeted by respondents whose most recent trip included Seward. *

Species targeted	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Halibut	204	72.1%	96	66.7%	108	77.7%
King salmon	78	27.6%	33	22.9%	45	32.4%
Silver salmon	149	52.7%	85	59.0%	64	46.0%
Other salmon	57	20.1%	31	21.5%	26	18.7%

* Percentages are out of the total number of respondents who targeted any species at this location.

Table A5.12. Species targeted by respondents whose most recent trip included Deep Creek/Ninilchik *.

Species targeted	All respondents		Alaskans		Non-Alaskans	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Halibut	250	92.6%	135	91.8%	115	93.5%
King salmon	136	50.4%	75	51.0%	61	49.6%
Silver salmon	49	18.1%	26	17.7%	23	18.7%
Other salmon	36	13.3%	13	8.8%	23	18.7%

* Percentages are out of the total number of respondents who targeted any species at this location.

Table A5.13. Most recent Kenai fishing trip catch (kept per day, released per day, and total catch per day) for Kenai Peninsula saltwater sport fishing trips .*

Species Targeted		Either halibut or salmon	Halibut	King salmon	Silver salmon	Other salmon
Most recent 5-year trip		(n=915)	(n=768)	(n=338)	(n=231)	(n=128)
Halibut	Kept	0.79	0.92			
	Released	0.94	1.11			
	Total	1.74	2.02			
King salmon	Kept	0.13		0.26		
	Released	0.10		0.20		
	Total	0.23		0.46		
Silver salmon	Kept	0.36			0.93	
	Released	0.16			0.42	
	Total	0.53			1.35	
Other salmon	Kept	0.30				1.24
	Released	0.46				1.76
	Total	0.75				3.00
Most recent 1997 trip		(n=644)	(n=542)	(n=230)	(n=182)	(n=99)
Halibut	Kept	0.78	0.90			
	Released	0.90	1.04			
	Total	1.68	1.95			
King salmon	Kept	0.13		0.27		
	Released	0.10		0.21		
	Total	0.23		0.47		
Silver salmon	Kept	0.42			1.06	
	Released	0.18			0.44	
	Total	0.60			1.50	
Other salmon	Kept	0.28				1.23
	Released	0.53				2.19
	Total	0.81				3.42

* The catch of the non-targeted species for each targeted trip, not reported here, are available on request.

Table A5.14. Most recent Kenai fishing trip (average weight for Kenai Peninsula saltwater sport fishing trips) where either halibut or saltwater salmon were fished for during the trip*

Species Targeted	Observations 5-year (1997)	Most recent 5-year trip	1997
Halibut	681 (486)	36.93	38.33
King salmon	180 (121)	29.68	29.40
Silver salmon	163 (129)	9.46	9.20
Other salmon	98 (68)	7.22	7.29

Table A5.15. Average daily expenditures for marine sport fishing trips off the Kenai Peninsula. ($)

	Kenai Peninsula residents	Other Alaska residents	Other US	Total	All Alaska residents
Observations	54	288	404	746	342
Auto or truck fuel	5.75	12.84	7.50	8.78	11.08
Auto or RV rental fees	3.53	1.30	13.73	9.49	1.86
Airfare	0.00	1.60	33.18	21.77	1.20
Other transportation	0.39	0.91	2.10	1.63	0.78
Total transportation expenditures	9.67	16.65	56.51	41.66	14.91
Lodging (trailer parks, campgrounds, hotels/motels)	2.71	10.85	23.51	18.27	8.83
Groceries	6.00	13.54	10.07	10.64	11.67
Restaurant and bar	5.33	10.18	10.42	9.91	8.97
Total food and lodging expenditures	14.04	34.58	44.01	38.82	29.46
Total transportation and lodging expenditures	23.70	51.23	100.51	80.48	44.38
Charter and guide fees (including tips)	8.38	31.86	97.46	60.56	24.57
Fishing gear (purchased only for trip)	3.04	5.20	15.02	9.71	4.53
Processing	1.10	2.39	19.41	10.59	1.99
Derby	0.94	0.67	1.00	0.87	0.75
Boat fuel and repairs	13.52	11.01	4.31	8.10	11.79
Haulout and moorage fees	4.10	2.52	1.07	2.05	3.01
Total fishing expenditures	31.07	53.65	138.27	91.88	46.65
Other expenditures		0.24	4.84	3.17	0.18
Total of all expenditures on a non-fishing day*	23.70	51.23	100.51	80.48	44.38
Total of all expenditures on a fishing day**	54.77	105.12	243.62	175.53	91.20

* Total transportation and lodging expenditures (calculated by dividing the weighting the per day trip expenditures (all days spent on trip) by days spent on the Kenai).

** The sum of the total of all expenditures plus other expenditures plus total fishing expenditures.

Table A5.16. Average daily expenditures for respondents reporting a positive expenditure.

	Alaskans	Other US	Total
Auto or truck fuel	12.89	11.63	12.16
Auto or RV rental fees	33.35	41.49	40.79
Airfare	41.49	56.75	56.34
Other transportation	18.96	50.40	46.09
Lodging (trailer parks, campgrounds, hotels/motels)	19.19	33.17	29.47
Groceries	14.31	11.50	12.46
Restaurant and bar	14.09	12.45	12.93
Charter and guide fees (including tips)	70.97	134.05	113.35
Fishing gear (purchased only for trip)	9.42	27.92	19.06
Processing	9.97	35.67	28.64
Derby	3.10	5.21	4.02
Boat fuel and repairs	29.25	31.45	29.80
Haul out and moorage fees	14.08	14.48	14.18